2105

INTEGRATED ENVIRONMENTAL MONITORING STATUS REPORT FOR FOURTH QUARTER 1998

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

MARCH 1999

U.S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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LIST OF ACRONYMS

AMS	air monitoring station
BTV	benchmark toxicity value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FFCA	Federal Facilities Compliance Agreement
FRL	final remediation level
gpm	gallons per minute
IEMP	Integrated Environmental Monitoring Plan
lbs	pounds
M gal	million gallons
MDC	minimum detectable concentration
mg/L	milligrams per liter
mrem	millirem
NESHAP	National Emissions Standards for Hazardous Air Pollutant
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan
OSDF	on-site disposal facility
pCi/L	picoCuries per liter
pCi/m^3	picoCuries per cubic meter
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
TLD	thermoluminescent dosimeter
$\mu g/L$	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter

1.0 GROUNDWATER MONITORING UPDATE

1.1 INTRODUCTION

This section summarizes the fourth quarter 1998 operational data for the aquifer remedy and third quarter 1998 analytical data from groundwater monitoring including project-specific on-site disposal facility data. This section is consistent with the groundwater reporting requirements presented in the Integrated Environmental Monitoring Plan (IEMP), Revision 0, (DOE 1997b) groundwater monitoring program.

Figure 1-1 shows the data included in this section. Figure 1-2 identifies the IEMP groundwater monitoring wells by module/monitoring activity and Figure 1-3 shows the IEMP routine water-level (groundwater elevation) monitoring wells. Figure 1-4 shows the location of the active aquifer restoration modules and extraction/re-injection wells.

1.2 FINDINGS

The principal findings from the reporting period are summarized below:

Operational Summary

- The South Field (Phase 1) Extraction Module continued to operate during the fourth quarter of 1998. With the exception of Extraction Wells 31564, 31565, and 31566, all extraction wells in the system were pumped for the majority of the period at or above the rates specified in the Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1) (DOE 1997a). The module target pumping rate for the combined 10 pumping wells was 1500 gallons per minute (gpm). Table 1-1 provides operational details for this module. Figures 1-5 through 1-14 present daily pumping rates and operational percentages for each well and additionally identify well outages lasting longer than 24 hours. Figure 1-15 provides the weekly average total uranium concentrations for each extraction well in this module.

- The South Plume Optimization Module continued to operate during the fourth quarter of 1998. Other than December, the two optimization wells were pumped for the majority of the period at the rates specified in the Baseline Remedial Strategy Report. The combined South Plume/South Plume Optimization Module target pumping rate was 2000 gpm. Table 1-2 provides operational details for the South Plume/South Plume Optimization Module. Figures 1-16 through 1-21 present daily pumping rates and operational percentages for each well. Figure 1-22 depicts the weekly average total uranium concentrations for each well in this module.

- The Re-Injection Demonstration Module continued to operate during the fourth quarter of 1998. The five re-injection wells re-injected groundwater at the rates specified in the Baseline Remedial Strategy Report for the majority of the period. The target re-injection rate for this module was 1000 gpm. Table 1-3 provides operational details for this module and Figures 1-23 through 1-27 present daily re-injection rates and operational percentages for each well.

- Table 1-4 summarizes the operational data from the three active restoration modules for the fourth quarter of 1998. The South Plume/South Plume Optimization and South Field (Phase 1) Extraction Modules pumped a total of 430 million gallons of groundwater and removed 203 pounds of total uranium during this reporting period. The Re-Injection Demonstration Module re-injected 110 million gallons of groundwater back into the aquifer for a net total extraction of 320 million gallons. To date 4.4 billion gallons of groundwater have been pumped and 814 pounds of total uranium have been removed from the aquifer since the South Plume Module began operating in August 1993. Figure 1-28 depicts the total groundwater pumped versus groundwater treated during the fourth quarter. Figure 1-29 shows the removal efficiencies for the South Field (Phase 1) Extraction and South Plume/South Plume Optimization Modules.

- Daily average pumping and re-injection rates for extraction and re-injection wells are shown in Figures 1-5 through 1-14, 1-16 through 1-21, and 1-23 through 1-27, respectively. The "hours in the reporting period" vary slightly from one figure to another because flow rate readings are taken each eight hour shift but not always at exactly the same time each day. For example, there were 91 days or 2184 hours in the fourth quarter; however, if the first flow rate reading of the quarter was taken at 1 p.m. and the last reading of the quarter was taken at 8 p.m., then the total hours would be 2191 instead of 2184.

Total Uranium Plume

- Figure 1-30 depicts the total uranium plume extent updated with total uranium concentration data collected during the third quarter of 1998. Total uranium concentration data used to update this map were obtained from the South Plume/South Plume Optimization and South Field (Phase I) Extraction Modules, along with the Resource Conservation and Recovery Act (RCRA) Property Boundary and Private Well Monitoring Programs, and Geoprobe data collected as part of the Re-Injection Demonstration. All total uranium concentrations above the 20 micrograms per liter (μg/L) final remediation level (FRL) are within the currently projected 10-year, uranium-based restoration footprint.

- Data collected quarterly from the aquifer are used to progressively update the total uranium plume in the following manner:

  - Total uranium concentration data from the most recent quarter are posted on a map with the contours from the previous IEMP quarterly status report. The highest total uranium value of Type 2, 3, or 4 wells at a cluster is selected.

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- If the most recent quarterly concentration from a well is greater than the concentration contour value at that location, then the plume is re-contoured to honor the higher value.

- At some locations the plume is migrating beneath the Type 2 well screen and above the Type 3 well screen based on Geoprobe profile sampling data in the area. At these locations, if the quarterly concentration measurement from a well is less than what is contoured for that location, then the new data are posted but the plume contours are not adjusted to honor the new data.

- For this report, the total uranium plume map shown in Figure 1-30 was revised in the South Field area around Extraction Well 31561 and Monitoring Wells 2049 and 2385, and in the South Plume area around Extraction Well 3926. The plume was re-contoured in the South Field area to honor higher total uranium values than those presented in the last IEMP quarterly status report. The change to the South Plume area was a result of the plume being drawn toward Extraction Well 3926 which had a third quarter total uranium concentration of 18 μg/L.

- In support of the Re-Injection Demonstration, the total uranium plume profile data were collected using a Geoprobe at locations 123769B, 12372B, and 12373B during the third quarter of 1998.

  - Cross-Section C-C', shown in Figure 1-31, consists of data collected at three locations, immediately east, west, and south (downgradient) of Re-Injection Well 22109 before starting re-injection. Re-Injection Well 22109 is located in an area of the total uranium plume that has total uranium concentrations over 400 μg/L. These three locations will be re-sampled using the Geoprobe on a quarterly basis during the Re-Injection Demonstration to determine what effect re-injection and pumping is having on the plume. The third round of Geoprobe sampling at these three locations was initiated in late December 1998 and continued through early January 1999; these data will be reported in the next IEMP quarterly status report.

Groundwater Elevation Data and Capture Assessment

- Routine groundwater elevations for the fourth quarter of 1998 were collected in October and are contoured in Figures 1-32 and 1-33 for the Type 2 and Type 3 monitoring wells, respectively. Figures 1-34 and 1-35 present detailed maps around the active restoration modules in the South Plume for the Type 2 and Type 3 monitoring wells, respectively. All the water elevation maps indicate the entire southern total uranium plume is within the capture zone produced by the active aquifer restoration modules.

- An additional groundwater elevation contour map, Figure 1-36, is provided in this report. The groundwater elevation contours shown in this figure were derived from groundwater elevations in Type 2 monitoring wells only; groundwater elevations from the extraction wells were not used in the gridding and contouring process. This figure

is presented as a comparison to the conventional groundwater elevation map in Figure 1-34 and addresses a concern that the gridding and contouring process used in constructing the conventional maps may overestimate the impact pumping has on the aquifer due to the relatively low elevations within the extraction wells when compared with groundwater elevations in nearby monitoring wells. These elevations may differ significantly because groundwater elevations within the extraction wells are a function of well efficiency. This difference can be seen in the conventional elevation map in Figure 1-34 by comparing the groundwater elevations in Extraction Well 31565 with the elevation observed in Monitoring Well 2016 which is approximately 50 feet away from the extraction well. The observed elevation difference is 4.6 feet. The locations of these wells are indicated with an arrow on both figures. The gridding and contouring process has honored this difference in elevation between the extraction and monitoring well where they exist in close proximity. However, in areas around extraction wells where no nearby monitoring wells exist, the gridding and contouring process tends to overestimate the impact of the extraction well on the aquifer. The U.S. Department of Energy (DOE) intends to provide further discussion of this issue in future technical meetings with the U.S. Environmental Protection Agency (EPA) and the Ohio Environmental Protection Agency (OEPA).

- Table 1-5 presents the results of the Paddys Run Road Site (PRRS) indicator constituent monitoring for the third quarter of 1998. These constituents are monitored to confirm that pumping from the South Plume/South Plume Optimization Module is having a negligible impact on the PRRS contaminant plumes. As in previous IEMP quarterly status reports, PRRS indicator constituent concentrations either remained within or were below historical minimum-maximum ranges. Due to start-up of the South Plume/South Plume Optimization and Re-Injection Demonstration Modules, special monitoring for arsenic occurred on a weekly basis from August to mid-October. Consequently, Table 1-5 presents the maximum of all arsenic results for the third quarter of 1998. For the third quarter of 1998, there appears to be no impact to the PRRS plume based on the data shown in Table 1-5. In addition, during the third quarter of 1998, no volatile organic compounds were detected in the monitoring wells used to evaluate impacts to the PRRS plume.

- Groundwater flow direction measurements were taken in two areas with the colloidal borescope during the fourth quarter of 1998: south of the South Plume/South Plume Optimization Module, and in the area of the northeastern lobe of the total uranium plume. No flow direction measurements were collected at Monitoring Well 2551 due to lack of access, although access was granted during the first quarter of 1999. These measurements, provided in Table 1-6 and shown in Figure 1-37, were obtained from November 16 through December 2, 1998, when the Re-Injection Demonstration, South Field (Phase 1) Extraction, and South Plume/South Plume Optimization Modules were operational. Several of the measured flow directions changed significantly from the measurements taken during the third quarter of 1998.

- The most notable difference in flow directions occurred at Monitoring Well 3900, located southeast of Extraction Well 3925. Flow directions shifted from 271° during the third quarter to 77.9° during the fourth quarter. Flow direction measurements

were obtained from this well on November 16, 1998, while the aquifer restoration modules were operating. Similar to Monitoring Well 3900, flow directions during the fourth quarter also varied from previous quarters for Monitoring Wells 2093, 3898, and 3899. For Monitoring Well 2093, flow directions shifted from 211° during the third quarter to 124° during the fourth quarter. For Monitoring Well 3898, flow directions shifted from 205° to 74° during the fourth quarter. For Monitoring Well 3899, flow directions shifted from 246° to 6.5° during the fourth quarter. In general, the direction of flow shift was similar for Monitoring Wells 3898, 3899, and 3900. Water levels in all wells were three to four feet lower during the fourth quarter than in the third quarter. The reduced water table is due to seasonally low rainfall and operation of additional extraction wells. These measurements will be repeated during the first quarter of 1999 and will be reported in the Integrated Environmental Monitoring Status Report for First Quarter 1999.

- Borescope data collected at Monitoring Wells 21063 and 2093 on December 1 and 2, 1998, respectively, indicate that capture may not have extended far enough to the east to contain the northeast lobe of the 20 μg/L total uranium plume. At the time that the borescope measurements were collected, the South Plume/South Plume Optimization Module was being operated at aggressive pumping rates (refer to Figure 1-37). These rates are used when all, or nearly all, the site's water treatment capacity is available for treating groundwater and the 20 μg/L monthly total uranium discharge limit is being easily achieved. Aggressive pumping rates in Extraction Wells 3926 and 3927 are 100 gpm lower than their baseline target pumping rates and aggressive pumping rates in Extraction Wells 32308 and 32309 are 100 gpm higher than their baseline target pumping rates. The objective of aggressive pumping is to pump more from areas of the plume with higher concentrations and less from areas of the plume with lower concentrations. It is not DOE's intent to forfeit plume capture in the name of optimization. Additional borescope and water elevation data will be collected in the coming months to optimize the aggressive pumping rates used for South Plume/South Plume Optimization extraction wells so that capture of the northeast lobe is maintained.

- Figure 1-38 shows the predicted steady state groundwater elevations from the groundwater model with the South Field (Phase 1) Extraction, Re-Injection Demonstration, and South Plume/South Plume Optimization Modules operating as specified in the Baseline Remedial Strategy Report. The 10-year, uranium-based restoration footprint (capture zone) and the third quarter 1998 total uranium plume outline are also shown in the figure along with the interpreted capture zones from the October 1998 Type 2 groundwater elevation map. As shown in the figure, the modeled capture zone, which shows the maximum extent of the combined capture zones, is in close agreement with the interpreted capture zones from each module; the 20 μg/L total uranium plume is within both the interpreted and modeled capture zones.

- As discussed in previous IEMP quarterly status reports, groundwater flow directions inferred from elevation measurements agree with predicted flow directions from the groundwater model except in the area of the northeastern lobe of the total uranium plume. This discrepancy between observed and predicted groundwater flow directions is being addressed with the groundwater model upgrade project. Phase I of the model

upgrade has been completed and Phase II is anticipated to begin during the second quarter of 1999. When the VAM3DF groundwater model is available, this portion of the model will be re-calibrated to bring model predictions more in line with observed flow.

Non-Uranium Final Remediation Level (FRL) Exceedances

- For the third quarter of 1998, the annual list of constituents identified in the IEMP were sampled and FRL exceedances were observed at 14 well locations. A total of seven constituents were observed at concentrations exceeding their FRL: antimony, boron, total chromium, manganese, nickel, lead, and zinc. Of the 14 well locations with FRL exceedances, all but four are within the 10-year, uranium-based restoration footprint (refer to Table 1-7 and Figure 1-39). The four monitoring wells with FRL exceedances outside the 10-year, uranium-based restoration footprint are along the eastern boundary of the Fernald Environmental Management Project (FEMP) and are monitored under the RCRA Property Boundary Monitoring Program.

- All four monitoring wells (2424, 2431, 4067, and 41217) with FRL exceedances outside the 10-year, uranium-based restoration footprint had exceedances for zinc. Monitoring Well 4067 also had an exceedance for total chromium.

  - As discussed in Appendix A.4 of the 1997 Integrated Site Environmental Report (DOE 1998a), observed exceedances could be due to zinc (and manganese) accumulation around the monitoring wells due to biofouling conditions. Subsequently, Monitoring Wells 2426 and 2431 were treated for biofouling prior to the third quarter sample event. There were no exceedances associated with Monitoring Well 2426 for any constituent during the third quarter of 1998. Monitoring Well 2431 had no manganese exceedances, however, there was a zinc exceedance as identified in Table 1-7. An additional well, Monitoring Well 2430, was treated, if necessary, in October 1998 (fourth quarter) after the fourth quarter sample event.

  - The additional monitoring wells (2424, 4067, and 41217) with exceedances are also monitored under the RCRA Property Boundary Monitoring Program. Sampling results from the RCRA Property Boundary wells are also being analyzed for iron, which began in July 1998, to determine if a correlation exists between increasing iron concentrations and increasing manganese and zinc concentrations. Quarterly sampling results from these wells will be evaluated to determine whether the accumulation of zinc and manganese is from biofouling and if whether the well treatment process lowers the manganese and zinc concentrations. As the third quarter was the first time iron has been analyzed, it is not possible to make correlations at this time. Sampling results from the end of 1998 for these wells will be reported in future IEMP reports.

  - There was only one total chromium exceedance outside the 10-year, uranium-based restoration footprint. However, the FRL is for hexavalent

chromium rather than total chromium as identified in the Record of Decision for Remedial Actions at Operable Unit 5 (DOE 1996) and in the IEMP. Because of the short laboratory holding times for hexavalent chromium, DOE is instead sampling for total chromium and making the conservative assumption that any exceedance for total chromium is an exceedance for hexavalent chromium. An investigation of the valence state of chromium in groundwater at the FEMP is being conducted to determine if hexavalent chromium is indeed present. Results from this study will be reported in future IEMP reports.

- Non-uranium FRL exceedances within the 10-year, uranium-based restoration footprint occurred at 10 wells: 2049 (boron); 2106 (total chromium); 2385 (manganese and zinc); 2386 (antimony, total chromium, manganese, and nickel); 2387 and 2398 (total chromium and nickel); 3385 (total chromium, manganese, and zinc); 3387 (total chromium, lead, manganese, nickel, and zinc); 3397 (zinc); and 3880 (manganese). Because these exceedances lie within the 10-year, uranium-based restoration footprint, they will be subject to containment by the aquifer restoration modules.

- As discussed above, DOE is evaluating how much of the total chromium detected at the FEMP is in the hexavalent state. A focused and limited sampling program is ongoing to investigate the presence of hexavalent chromium in the Great Miami Aquifer at the FEMP. Groundwater samples collected during the fourth quarter were analyzed for total chromium, hexavalent chromium, and manganese at Monitoring Wells 2032, 2054, 2648, 2386, 2398, 3032, 3045, and 41217. Insitu redox and pH measurements at the same monitoring well locations were initiated during the fourth quarter and have not yet been completed. Results of this study will be reported in the 1998 Integrated Site Environmental Report and, if necessary, in future IEMP quarterly status reports.

  In accordance with Appendix A of the 1997 Integrated Site Environmental Report, DOE has reviewed historic data on chloride concentrations in monitoring wells with nickel and chromium exceedances to determine whether a correlation between chloride concentrations in the aquifer and the observed increase in nickel and chromium concentrations exists. After review of these historical concentrations, DOE does not believe there is a correlation between nickel, chromium, and chloride concentrations in the aquifer.

KC-2 Warehouse Well Analytical Results

- Sampling of this well (Well 67) in August 1998 revealed lower concentrations of hazardous substance list metals than routinely indicated in previous sampling results. Table 1-8 presents historical statistics as well as the August 1998 results.

On-Site Disposal Facility Sampling

Status for Cell 1:

- After placement of waste was initiated in Cell 1, quarterly sampling commenced and continues to be conducted as specified in the On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan (DOE 1997c). During the third quarter of 1998, quarterly samples were collected from the leachate collection system, horizontal till well, and Great Miami Aquifer for Cell 1. The leak detection system was dry during the third quarter; therefore, no samples were collected.

  Results from the sampling in August 1998 indicate no exceedances of the interim control limits calculated from baseline conditions.

  Concentrations from the leachate collection system (12338C) during the third quarter of 1998 were all non-detectable with the exception of total organic carbon, total organic halogens, boron, and total uranium which had concentrations of 18.5 milligrams per liter (mg/L), 0.0308 mg/L, 0.337 mg/L, and 47 μg/L, respectively. Compared to second quarter results, all detections except boron decreased. Trend analysis will be presented in IEMP annual integrated site environmental reports. Leachate volumes for the third quarter of 1998 were as follows: July (617,816 gallons); August (996,682 gallons); and September (167,968 gallons). Sampling for the required annual list of constituents for the Cell 1 leachate collection system (identified in Table B-2 of the On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan) was conducted during the fourth quarter and the data will be provided in future IEMP annual integrated site environmental reports.

  (Figure 1-40 identifies the well locations.)

Status for Cell 2:

- For the third quarter of 1998, one baseline aquifer sampling event was completed for a total of 13 baseline samples for Cell 2. As Table 1-9 identifies, three of the 16 constituents sampled were detected in the Great Miami Aquifer.

- For the third quarter of 1998, 13 baseline horizontal till well sampling events were completed for a total of 14 baseline samples for Cell 2. As Table 1-9 identifies, by the end of the third quarter, there were a total of 13 sample results instead of 14 for most chemical constituents due to a sample set being misplaced during transit to the laboratory. Additionally, the laboratory analyzed one sample incorrectly; therefore, there were only 12 results for mercury. As Table 1-9 identifies, six of the 16 constituents sampled were detected in the horizontal till well. Three additional baseline samples were collected during the fourth quarter for a total of 17 baseline samples for Cell 2. These baseline results will be presented in the next IEMP quarterly status report.

- Waste placement for Cell 2 was initiated on November 12, 1998. A technical memorandum associated with baseline groundwater conditions is forthcoming. Sampling of the aquifer and horizontal till well continues after initiation of waste placement and the data will be provided in future IEMP quarterly status and annual integrated site environmental reports.

- Sampling of the leachate collection system and the leak detection system for Cell 2 (12339C and 12339D, respectively) was initiated during the fourth quarter after waste placement. Sampling for the required annual list of constituents for the Cell 2 leachate collection system (identified in Table B-2 of the On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan) was conducted during the fourth quarter after initiation of waste placement. The data from these systems will be provided in future IEMP annual integrated site environmental reports.

  (Figure 1-40 identifies the well locations.)

Status for Cell 3:

- For the third quarter of 1998, two baseline aquifer sampling events were completed for Cell 3 for a total of two baseline samples. As Table 1-9 identifies, four of the 16 constituents sampled were detected in the Great Miami Aquifer.

- For the third quarter of 1998, three horizontal till well baseline sampling events were completed for Cell 3 for a total of three baseline samples. As Table 1-9 identifies, four of the 16 constituents sampled were detected in the horizontal till well.

- Baseline sampling for the Great Miami Aquifer and for the horizontal till well continued through December 1998. Three aquifer baseline samples were collected during the fourth quarter for a total of five baseline samples. Three baseline samples were collected for the horizontal till well during the fourth quarter for a total of six baseline samples. The data will be provided in future IEMP annual integrated site environmental reports.

  (Figure 1-40 identifies the well locations.)

The next IEMP quarterly status report, to be issued June 28, 1999, will include operational data and plume capture assessment from January through March 1999 (first quarter). However, analytical information from the fourth quarter of 1998 to be used for determining aquifer conditions will be presented in the 1998 Integrated Site Environmental Report to be submitted June 1, 1999. Figure 1-41 shows the data from groundwater sampling activities that will be included in the next IEMP quarterly status report.

TABLE 1-1

SOUTH FIELD (PHASE 1) EXTRACTION MODULE OPERATIONAL SUMMARY SHEET FOR FOURTH QUARTER (OCTOBER THROUGH DECEMBER 1998)

Extraction Well	31565	31564	31566[a,b]	31563	31567	31550	31560	31561	31562	32276
	Baseline Remedial Strategy Report Target Pumping Rates (gpm)									
	200	200	200	200	100	100	100	100	100	200
	Monthly Average Well Pumping Rates (gpm)									
October	182	187	0	181	94	92	94	94	187	275
November	139	133	NA	88	97	133	152	101	209	293
December	182	181	NA	162	100	124	118	98	194	300
Quarterly Average	168	167	0	144	97	116	121	98	197	289
	Monthly Average Well Concentrations for Total Uranium (µg/L)									
October	12.4	13.8	6.6	49.3	35.1	87.6	146.4	50.3	114.1	205.8
November	12.9	12.3	26.5[c]	40.3	36.9	79.9	138.2	45.9	113.7	195.1
December	14.8	15.0	20.9[c]	40.0	37.2	76.3	138.2	46.9	116.4	194.6
Quarterly Average	13.4	13.7	18.0	43.2	36.4	81.3	140.9	47.7	114.7	198.5
	Monthly Average Well Efficiencies (Pounds of Total Uranium Removed/Million Gallons Pumped)									
October	0.10	0.12	0.06	0.41	0.29	0.73	1.22	0.42	0.95	1.72
November	0.11	0.10	NA	0.34	0.31	0.67	1.15	0.38	0.95	1.63
December	0.12	0.13	NA	0.33	0.31	0.64	1.15	0.39	0.97	1.62
Quarterly Average	0.11	0.12	NA	0.36	0.30	0.68	1.17	0.40	0.96	1.66

	Monthly Average Module Pumping Rate (gpm)	Water Pumped by Extraction Module (M gal)	Monthly Total Uranium Concentration from Extraction Module[d] (µg/L)
October	1387	61.79	94.3
November	1344	58.26	109.2
December	1460	64.92	88.3
Quarterly Average	1397	Total 184.97	Quarterly Average 97.3

[a]Extraction Well 31566 was shut down in November and December. See Figure 1-12 for details.
[b]NA = not applicable
[c]Unusually high total uranium concentrations for November and December are being investigated.
[d]Average is calculated from individual well concentrations and flow rates.

TABLE 1-2

SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULE OPERATIONAL SUMMARY SHEET FOR FOURTH QUARTER (OCTOBER THROUGH DECEMBER 1998)

Extraction Well	3924	3925	3926	3927	32308	32309
	Baseline Remedial Strategy Report Target Pumping Rates (gpm)					
	300	300	400	400	250	250
	Monthly Average Well Pumping Rates (gpm)					
October	273	285	372	456	236	234
November	299	299	343	438	307	307
December	291	271	367	447	159	169
Quarterly Average	288	285	361	447	234	237
	Monthly Average Well Concentrations for Total Uranium (μg/L)					
October	37.4	34.3	15.8	1.1	73.4	90.1
November	41.2	33.6	15.0	1.2	71.2	82.2
December	46.2	35.3	17.6	1.0	75.4	79.4
Quarterly Average	41.6	34.4	16.1	1.1	73.3	83.9
	Monthly Average Well Efficiencies (Pounds of Total Uranium Removed/Million Gallons Pumped)					
October	0.31	0.29	0.13	0.01	0.61	0.75
November	0.34	0.28	0.13	0.01	0.59	0.69
December	0.39	0.29	0.15	0.01	0.63	0.66
Quarterly Average	0.35	0.29	0.14	0.01	0.61	0.70

	Monthly Average Module Pumping Rate (gpm)	Water Pumped by Extraction Module (M gal)	Monthly Total Uranium Concentration from Extraction Module[a] (μg/L)
October	1856	82.61	28.7
November	1993	86.14	33.1
December	1704	76.07	48.2
Quarterly Average	1851	Total 244.82	Quarterly Average 36.7

[a]Average is calculated from individual well concentrations and flow rates.

TABLE 1-3

RE-INJECTION DEMONSTRATION MODULE OPERATIONAL SUMMARY SHEET FOR FOURTH QUARTER (OCTOBER THROUGH DECEMBER 1998)

Re-Injection Well	22107	22108	22109	22240	22111
	Baseline Remedial Strategy Report Target Re-Injections Rates (gpm)				
	200	200	200	200	200
	Monthly Average Well Re-Injection Rates (gpm)				
October	130	186	186	186	186
November	196	197	196	197	197
December	128	127	128	127	126
Quarterly Average	151	170	170	170	170

	Monthly Average Module Re-Injection Rate (gpm)	Water Re-Injected by Module (M gal)
October	874	38.93
November	983	42.52
December	636	28.44
Quarterly Average	831	36.63

TABLE 1-4

AQUIFER RESTORATION SYSTEM
OPERATIONAL SUMMARY SHEET FOR FOURTH QUARTER
(OCTOBER THROUGH DECEMBER 1998)

	Gallons Pumped/Re-Injected this Reporting Period (M gal)	Total Uranium Removed/Re-Injected this Reporting Period[a] (lbs)	Average System Efficiency this Reporting Period[a] (lbs/M gal)	Gallons Pumped/Re-Injected from August 1993 to December 1998 (M gal)	Total Uranium Removed/Re-Injected from August 1993 to December 1998[a] (lbs)	System Efficiency from August 1998 to December 1998[a] (lbs/M gal)
South Field (Phase 1) Extraction Module	184.97	128.43	0.69	353.699	239.73	0.68
South Plume/South Plume Optimization Module	243.28	74.41	0.30	3,583.334	574.61	0.16
Re-Injection Demonstration Module	109.89	NA	NA	150.891	NA	NA
Aquifer Restoration System Totals						
(pumped)	429.78	202.84	0.47	4,366.814	814.34	0.19
(re-injected)	109.89	NA	NA	150.891	NA	NA
(net)	319.89	202.84	NA	4,215.923	814.34	NA

[a]NA = not applicable

TABLE 1-5

PADDYS RUN ROAD SITE GROUNDWATER SUMMARY STATISTICS

	Sampling Period							
	January 1, 1988 - September 30, 1998						Results with Detections for Third Quarter 1998	
	Monitoring Well	Number of Samples[a,b,c]	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d] (mg/L)	SD[a,b,c,d] (mg/L)	Sample Result[e] (mg/L)	Validation Qualifier[f]
Arsenic[g]	2128	204	0.0006	0.1876	0.013	0.022	0.0024	NV
	2548	103	0.00065	0.35	0.027	0.040	NS	NA
	2625	196	0.0048	0.05	0.012	0.008	0.0192	J
	2636	169	0.01	0.0939	0.04	0.02	0.0551	NV
	2898	22	0.00035	0.0063	0.0017	0.0014	0.003	-
	2899	21	0.00035	0.003	0.0013	0.0008	0.0018	U
	2900	203	0.0007	0.0548	0.005	0.005	0.0031	NV
	3128	24	0.00085	0.234	0.013	0.047	0.0054	-
	3636	23	0.00075	0.014	0.0021	0.0027	0.0018	U
	3898	21	0.00095	0.0062	0.0022	0.0012	0.0023	-
	3899	22	0.00035	0.003	0.0014	0.0008	0.0018	U
	3900	22	0.0012	0.0045	0.0025	0.00095	0.0028	-
Phosphorus	2128	32	0.04	16.2	2.2	3	0.08	UJ
	2548	12	0.0855	5.4	1.7	1.5	NS	NA
	2625	22	0.307	12.3	3.25	3.31	8.84	J
	2636	21	9.6	170	90	50	73.00	J
	2898	23	0.005	1.05	0.09	0.2	0.025	UJ
	2899	20	0.005	0.11	0.04	0.03	0.025	UJ
	2900	21	0.07	0.96	0.45	0.26	NS	NA
	3128	31	0.005	13	0.5	2.3	0.025	UJ

TABLE 1-5
(Continued)

	Sampling Period							
	January 1, 1988 - September 30, 1998						Results with Detections for Third Quarter 1998	
	Monitoring Well	Number of Samples[a,b,c]	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d] (mg/L)	SD[a,b,c,d] (mg/L)	Sample Result[e] (mg/L)	Validation Qualifier[f]
Phosphorus (Contd.)	3636	22	0.0125	1.1	0.12	0.23	0.025	UJ
	3898	20	0.02	1.24	0.14	0.27	NS	NA
	3899	21	0.025	0.83	0.15	0.18	NS	NA
	3900	22	0.005	1.26	0.12	0.26	0.025	UJ
Potassium	2128	24	1.09	18	4.4	4.9	2.03	-
	2548	12	1.36	40	10	10	NS	NA
	2625	22	0.64	6.26	3.4	1.7	5.88	J
	2636	21	8.51	218	80.9	57.0	44.30	-
	2898	23	2.5	5.05	3.7	0.62	3.28	-
	2899	21	1.36	4.42	3.49	0.626	3.25	-
	2900	22	0.711	6	1.7	1	1.28	-
	3128	24	1.09	3.7	2.5	0.62	2.75	-
	3636	22	1.09	3.32	2.47	0.503	2.10	-
	3898	21	1.335	3.93	2.38	0.595	2.11	-
	3899	22	1.335	3.22	2.44	0.344	2.28	-
	3900	22	0.975	3.19	1.89	0.553	1.74	-
Sodium	2128	24	22.9	75.2	38.5	13.3	26.4	-
	2548	12	18.2	35	25	5.1	NS	NA
	2625	22	16.5	50.7	33.9	8.24	26.7	-
	2636	21	23	79.9	49	16	23	-
	2898	23	12.3	29.2	19.1	4.04	12.3	-

TABLE 1-5
(Continued)

	Sampling Period							
	January 1, 1988 - September 30, 1998						Results with Detections for Third Quarter 1998	
	Monitoring Well	Number of Samples[a,b,c]	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d] (mg/L)	SD[a,b,c,d] (mg/L)	Sample Result[e] (mg/L)	Validation Qualifier[f]
Sodium (Contd.)	2899	21	11.2	22.9	17.2	3.40	14.7	-
	2900	22	18.1	43.3	30.9	7.79	28.5	-
	3128	24	3.85	13.4	7.20	3.35	3.85	-
	3636	22	4.65	13	8.6	2.9	4.65	-
	3898	21	7.29	14.6	8.86	1.75	7.51	-
	3899	22	6.24	12.1	8.78	1.49	8.07	-
	3900	22	4.45	10.8	6.48	1.92	5.54	-

[a]The data are based on unfiltered samples from the Operable Unit 5 remedial investigation/feasibility study data set (1988 through 1993) and 1994 through 1997 groundwater data.
[b]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples, and the sample with the maximum concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation [SD]).
[c]Rejected data qualified with either a R or Z were not included in this count or the summary statistics.
[d]For results where the concentrations are below the detection limit, the results used in the summary statistics are each set at half the detection limit.
[e]NS = not sampled; Monitoring Well 2548 was not sampled because there is no access agreement with CSX railroad and there were no results for phosphorus from Monitoring Wells 2900, 3898, and 3899 because the laboratory did not analyze for it.
[f]NA = not applicable; validation qualifier codes are provided in Appendix D of the Sitewide CERCLA Quality Assurance Project Plan (DOE 1998g).
[g]Arsenic data for third quarter 1998 are the maximum of weekly samples collected. Weekly sampling was conducted from August 5, 1998 through October 14, 1998. As identified in the IEMP, Revision 0, if pumping rates for the South Plume System are modified, then arsenic sampling will be temporarily increased to weekly to ensure that new pumping rates have not impacted the Paddys Run Road Site.

TABLE 1-6

FOURTH QUARTER 1998 FLOW DIRECTION DATA FROM BORESCOPE OBSERVATIONS

Monitoring Well	Date of Observation	Feet Below Water Level	Average Flow Direction[a,b] (degrees)	Standard Deviation[b] (degrees)
2093	12/1	2.46	124.2	11.9
21063	12/2	32.38	119.4	10.6
22303	11/17	0.77	111.0	57.4
2551[c]	NA	NA	NA	NA
3551[c]	NA	NA	NA	NA
2552	12/1	7.84	102.6	4.5
3552	11/25	64.02	36.8	11.0
2898	11/19	0.59	104.25	4.1
3898	11/19	64.79	73.5	16.1
2899	11/18	0.74	96.5	8.2
3899	11/18	63.65	6.5	19.8
2900	11/16	3.54	320.7	5.5
3900	11/16	66.82	77.9	47.9

[a]Average flow direction is measured clockwise in degrees from magnetic north.
[b]Values are calculated after statistical filtering to remove outliers.
[c]NA = not applicable because monitoring well was not borescoped due to access problem with landowner.

TABLE 1-7

NON-URANIUM CONSTITUENTS WITH THIRD QUARTER 1998 RESULTS ABOVE FINAL REMEDIATION LEVELS

Constituent	Monitoring Well	Module/Monitoring Activity[a]	Number of Validated Samples Since 1988[b,c]	Number of Validated Samples with FRL Exceedances Since 1988[b,c]	Number of Validated Samples with FRL Exceedances for Third Quarter 1998[b,c]	FRL[d] (mg/L)	Validated Results with FRL Exceedances for Third Quarter 1998		
							Sample Result (mg/L)	Validation Qualifier[e]	Sample Date
Antimony						0.0060			
	2386	South Field	4	1	1		0.01	-	9/9/98
Boron						0.33			
	2049	South Field	5	3	1		0.592	-	9/9/98
Chromium, Total						0.022[f]			
	2106	RCRA, South Plume	24	3	1		0.0251	-	7/14/98
	2386	South Field	4	2	1		8.51	J	9/9/98
	2387	South Field	3	2	1		0.0795	J	9/9/98
	2398	RCRA, South Plume	22	10	1		0.201	-	7/7/98
	3385	South Field	3	2	1		0.0367	-	9/8/98
	3387	South Field	3	1	1		0.128	J	9/9/98
	4067	RCRA	25	1	1		0.0458	-	7/14/98
Lead						0.015			
	3387	South Field	3	1	1		0.0437	-	9/9/98
Manganese						0.90			
	2385	South Field	3	2	1		9.15	-	9/8/98
	2386	South Field	4	1	1		1.43	-	9/9/98
	3385	South Field	3	2	1		1.79	-	9/8/98
	3387	South Field	3	1	1		3.41	-	9/9/98
	3880	South Plume	3	1	1		1.18	-	8/5/98

TABLE 1-7
(Continued)

Constituent	Monitoring Well	Module/Monitoring Activity[a]	Number of Validated Samples Since 1988[b,c]	Number of Validated Samples with FRL Exceedances Since 1988[b,c]	Number of Validated Samples with FRL Exceedances for Third Quarter 1998[b,c]	FRL[d] (mg/L)	Validated Results with FRL Exceedances for Third Quarter 1998		
							Sample Result (mg/L)	Validation Qualifier[e]	Sample Date
Nickel						0.10			
	2386	South Field	4	1	1		1.42	-	9/9/98
	2387	South Field	3	1	1		0.179	-	9/9/98
	2398	RCRA, South Plume	22	8	1		0.324	-	7/7/98
	3387	South Field	3	1	1		0.141	-	9/9/98
Zinc						0.021			
	2385	South Field	3	1	1		0.0223	-	9/8/98
	2424	RCRA	22	6	1		0.239	-	7/14/98
	2431	RCRA	20	2	1		0.0492	-	7/15/98
	3385	South Field	3	2	1		0.0656	-	9/8/98
	3387	South Field	3	2	1		0.162	-	9/9/98
	3397	South Field	3	2	1		0.0301	-	9/8/98
	4067	RCRA	23	1	1		13.6	-	7/14/98
	41217	RCRA	20	2	1		0.0256	-	7/15/98

Note: Highlighting indicates well is outside the 10-year, uranium-based restoration footprint.

[a]From IEMP, Revision 0, Table 3-4
[b]If there was more than one sample result per day (e.g., a duplicate sample), then only the maximum sample concentration was counted and compared to the FRL.
[c]Rejected data qualified with either a R or Z were not used in this comparison.
[d]From Operable Unit 5 Record of Decision, Table 9-4
[e]Validation qualifier codes are provided in Appendix D of the Sitewide CERCLA Quality Assurance Project Plan.
[f]The FRL is based on chromium VI, from Operable Unit 5 Record of Decision, Table 9-4; however, the sampling results are for total chromium.

TABLE 1-8

KC-2 WAREHOUSE GROUNDWATER SUMMARY STATISTICS
(January 1993 through Third Quarter [August] 1998)

Constituent	Number of Samples[a,b]	FRL (mg/L)	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d,e] (mg/L)	SD[a,b,c,d,e] (mg/L)	1998 Data Sample Result (mg/L); Validation Qualifier[f]
Aluminum	12	NA	0.01055	80	14	25	0.0211 U
Antimony	12	0.0060	0.000065	0.22	0.052	0.071	0.00013 U
Arsenic	12	0.050	0.00065	0.0873	0.016	0.030	0.0018 U
Barium	12	2.0	0.103	0.867	0.362	0.258	0.247 -
Beryllium	12	0.0040	0.00001	0.005	0.0014	0.0016	0.00002 U
Cadmium	12	0.014	0.00003	0.0671	0.01	0.02	0.00006 U
Calcium	12	NA	46.3	1310	340	445	58.1 J
Chromium	12	0.022[g]	0.0015	2.35	0.4	0.8	0.003 U
Cobalt	12	0.17	0.000105	0.102	0.026	0.038	0.00021 U
Copper	12	1.3	0.000335	0.373	0.096	0.15	0.00067 U
Cyanide	4	NA	0.000985	0.0025	0.0018	0.00081	0.00197 U
Iron	12	NA	3.18	620	150	230	4.19 -
Lead	12	0.015	0.00062	3.8	0.80	1.3	0.00062 -
Magnesium	12	NA	33.9	322	103	105	35.2 -
Manganese	12	0.900	0.053	8.52	2.0	3.1	0.053 -
Mercury	12	0.0020	0.00005	0.0022	0.00034	0.0006	0.0001 U
Nickel	12	0.10	0.0011	1.21	0.25	0.41	0.0022 U
Potassium	11	NA	0.922	14.6	3.25	4.15	1.11 -
Selenium	12	0.050	0.00039	0.0099	0.0029	0.0028	0.0023 U
Silver	12	0.050	0.00025	0.0312	0.005	0.009	0.0005 U
Sodium	11	NA	17.5	23.9	20.4	1.92	20.7 -
Thallium	12	NA	0.000025	1.8	0.15	0.52	0.00005 U
Vanadium	12	0.038	0.00075	0.19	0.038	0.056	0.0015 U
Zinc	12	0.021	0.0061	1.79	0.39	0.58	0.0122 U
		(μg/L)	(μg/L)	(μg/L)	(μg/L)	(μg/L)	(μg/L)
Uranium, Total	12	20	0.2	2400	200	200	0.2 NV

[a]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples, and the sample with the maximum concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation [SD]).
[b]Rejected data qualified with either a R or Z were not included in this count or the summary statistics.
[c]For values where the concentrations are below the detection limit, the results used in the summary statistics are set at half the detection limit.
[d]If the total number of samples is greater than or equal to four, then all of the summary statistics are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
[e]NA = not applicable
[f]Validation qualifier codes are provided in Appendix D of the Sitewide CERCLA Quality Assurance Project Plan.
[g]The FRL is based on chromium VI, from Operable Unit 5 Record of Decision, Table 9-4; however, the sampling results are for total chromium.

TABLE 1-9

OSDF CELLS 2 AND 3 MONITORING WELL DATA WITH DETECTIONS FROM INCEPTION THROUGH THIRD QUARTER 1998 (June 1997 through September 1998)

Constituent (FRL)[a]	Cell	Monitoring Well	Number of Validated Samples Since June 1997[b,c]	Number of Validated Samples with Detections Since June 1997[b,c]	Number of Validated Samples with Detections for Third Quarter 1998[b,c]	Validated Results with Detections for Third Quarter 1998[b] Sample Result	Validation Qualifier[d]	Sample Date
Total Organic Carbon (NA)[e]	2	12339	13	13	12	1.1	-	7/14/98
						1.5	-	7/22/98
						1.2	-	7/28/98
						2.81	-	8/11/98
						4.22	J	8/20/98
						3.55	-	8/25/98
						1.3	-	9/8/98
						1.3	J	9/16/98
						2.6	J	9/21/98
						1.2	-	9/23/98
						1	J	9/28/98
						0.57	J	9/30/98
	2	22199	13	12	1	3.7	-	8/24/98
	2	22200	13	12	1	5.44	-	8/24/98
	3	12340	3	3	3	1	-	7/28/98
						2.79	-	8/25/98
						0.84	-	9/14/98
	3	22203	2	2	2	3.51	-	8/24/98
						1.8	-	9/14/98
	3	22204	2	2	2	5	-	8/24/98
						0.85	-	9/14/98

TABLE 1-9
(Continued)

Constituent (FRL)[a]	Cell	Monitoring Well	Number of Validated Samples Since June 1997[b,c]	Number of Validated Samples with Detections Since June 1997[b,c]	Number of Validated Samples with Detections for Third Quarter 1998[b,c]	Validated Results with Detections for Third Quarter 1998[b] Sample Result	Validation Qualifier[d]	Sample Date
Total Organic Halogens (NA)[e]	2	12339	13	9	9	0.0124	J	7/22/98
						0.023	-	7/28/98
						0.0612	-	8/11/98
						0.0487	J	8/20/98
						0.0358	-	8/25/98
						0.0301	-	9/8/98
						0.0121	J	9/16/98
						0.0316	-	9/28/98
						0.0182	-	9/30/98
	3	12340	3	2	2	0.0274	-	8/25/98
						0.0276	J	9/14/98
	3	22203	2	1	1	0.0171	J	9/14/98
	3	22204	2	1	1	0.014	J	9/14/98
Boron (0.33 mg/L)	2	12339	13	7	6	0.0502	-	7/14/98
						0.062	-	7/22/98
						0.0317	-	7/28/98
						0.0466	-	8/11/98
						0.0488	-	8/20/98
						0.0448	-	8/25/98
	2	22199	13	8	1	0.0398	-	8/24/98
	2	22200	13	7	1	0.0424	-	8/24/98
	3	12340	3	2	2	0.0425	-	7/28/98
						0.0322	-	8/25/98
	3	22203	2	1	1	0.0376	-	8/24/98
	3	22204	2	1	1	0.0416	-	8/24/98
Mercury (0.002 mg/L)	2	12339	12	1	1	0.00024	-	8/20/98

TABLE 1-9
(Continued)

Constituent (FRL)[a]	Cell	Monitoring Well	Number of Validated Samples Since June 1997[b,c]	Number of Validated Samples with Detections Since June 1997[b,c]	Number of Validated Samples with Detections for Third Quarter 1998[b,c]	Validated Results with Detections for Third Quarter 1998[b] Sample Result	Validation Qualifier[d]	Sample Date
Technetium-99 (94 pCi/L)	2	12339	14	5	5	8	J	7/14/98
						12	-	9/3/98
						4.93	J	9/8/98
						7.14	-	9/16/98
						5.47	-	9/21/98
Uranium, Total (20 μg/L)	2	12339	14	14	13	2.156	-	7/14/98
						2.489	-	7/22/98
						3.607	-	7/28/98
						1.832	-	8/11/98
						2.053	-	8/20/98
						1.708	-	8/25/98
						1.632	-	9/3/98
						1.719	-	9/8/98
						1.903	-	9/16/98
						1.932	-	9/21/98
						1.656	J	9/23/98
						1.55	J	9/28/98
						2.041	J	9/30/98
	2	22199	13	13	1	11.826	-	8/24/98
	2	22200	13	10	1	0.049	-	8/24/98
	3	12340	3	2	2	3.133	-	7/28/98
						2.056	-	8/25/98
	3	22203	2	2	2	0.491	J	8/24/98
						0.559	J	9/14/98
	3	22204	2	2	2	2.995	-	8/24/98
						0.804	-	9/14/98

[a]From Operable Unit 5 Record of Decision, Table 9-4
[b]If there was more than one sample collected per well per constituent per day (e.g., a duplicate sample), then only the maximum sample concentration was counted and compared to the FRL.
[c]Rejected data qualified with either a R or Z were not included in this count.
[d]Validation qualifier codes are provided in Appendix D of the Sitewide CERCLA Quality Assurance Project Plan.
[e]NA = not applicable

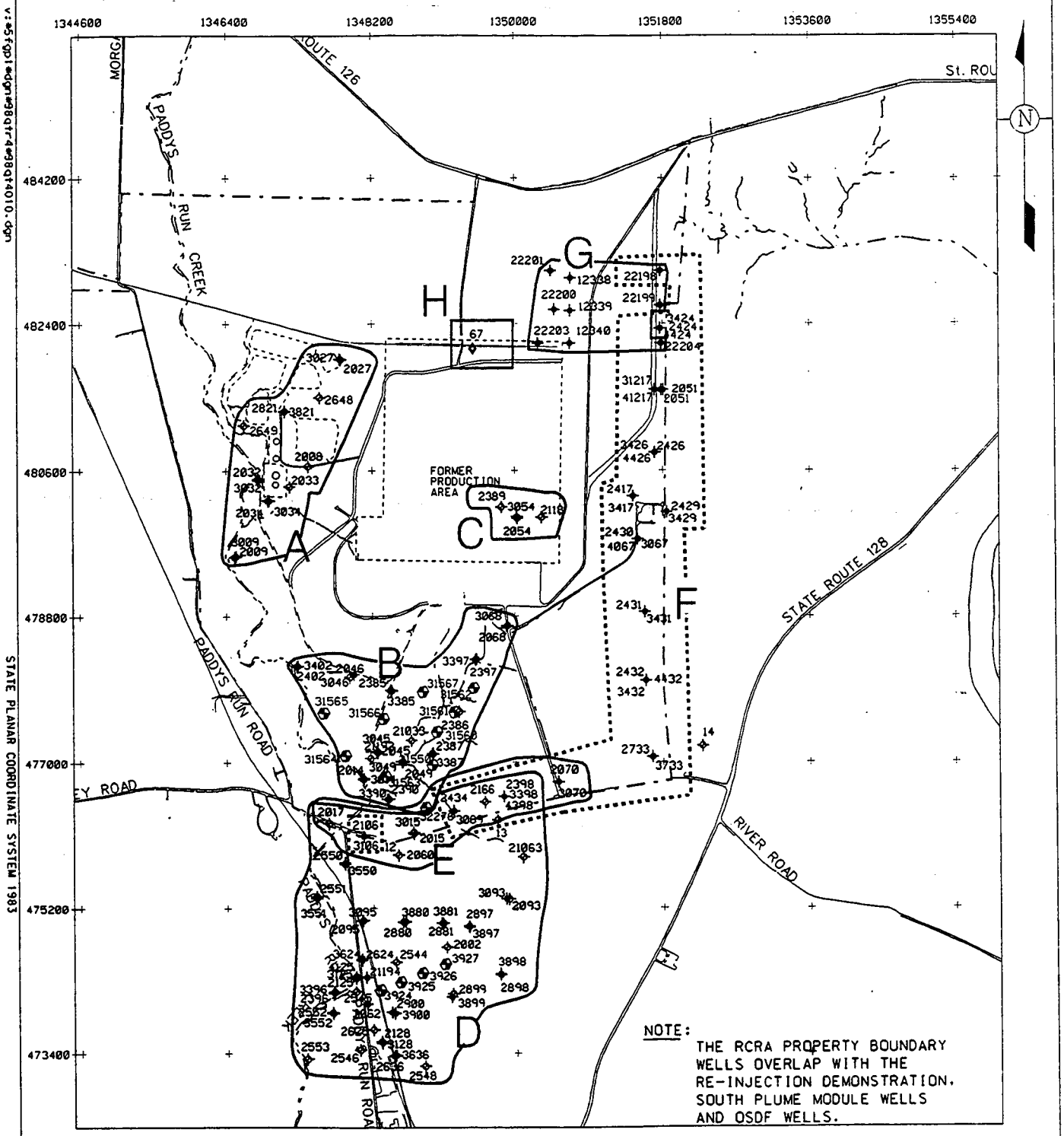
FIGURE 1-1

GROUNDWATER SAMPLING ACTIVITIES COVERED IN THIS QUARTERLY REPORT

SAMPLING ACTIVITIES	1998											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
South Plume/South Plume Optimization Modules:												
Operational										♦	♦	♦
Aquifer Conditions								♦				
South Field Extraction Module:												
Operational (Phase 1)										♦	♦	♦
Aquifer Conditions									♦			
Re-Injection Demonstration Module[a]:												
Operational										♦	♦	♦
Waste Storage Area Module:												
Aquifer Conditions												
Plant 6 Area Module:												
Aquifer Conditions												
Routine Water-Level/Flow Direction Monitoring										♦		
RCRA Property Boundary Monitoring							♦					
Private Well Monitoring							♦					
KC-2 Warehouse Monitoring								♦				
OSDF Groundwater Monitoring:												
Post-Baseline (Cell 1)								♦				
Baseline (Cell 2)							♦	♦	♦			
Baseline (Cell 3)							♦	♦	♦			

♦ Data summarized/evaluated in this report

[a]Aquifer conditions for this module are monitored under the South Plume Module, South Field Module, and the RCRA Property Boundary Program.



LEGEND:

- A - WASTE STORAGE AREA
- B - SOUTH FIELD EXTRACTION AREA
- C - PLANT 6 AREA
- D - SOUTH PLUME AREA
- E - RE-INJECTION DEMONSTRATION AREA
- F - RCRA PROPERTY BOUNDARY WELLS
- G - OSDF MONITORING WELLS
- H - KC-2 WAREHOUSE WELL

— · — · — FEMP BOUNDARY

MONITORING WELL

EXTRACTION WELL

SCALE

1800 900 0 1800 FEET

STATE PLANAR COORDINATE SYSTEM 1983

09-FEB-1999

FIGURE 1-2. IEMP WATER QUALITY MONITORING WELLS AND EXTRACTION WELLS

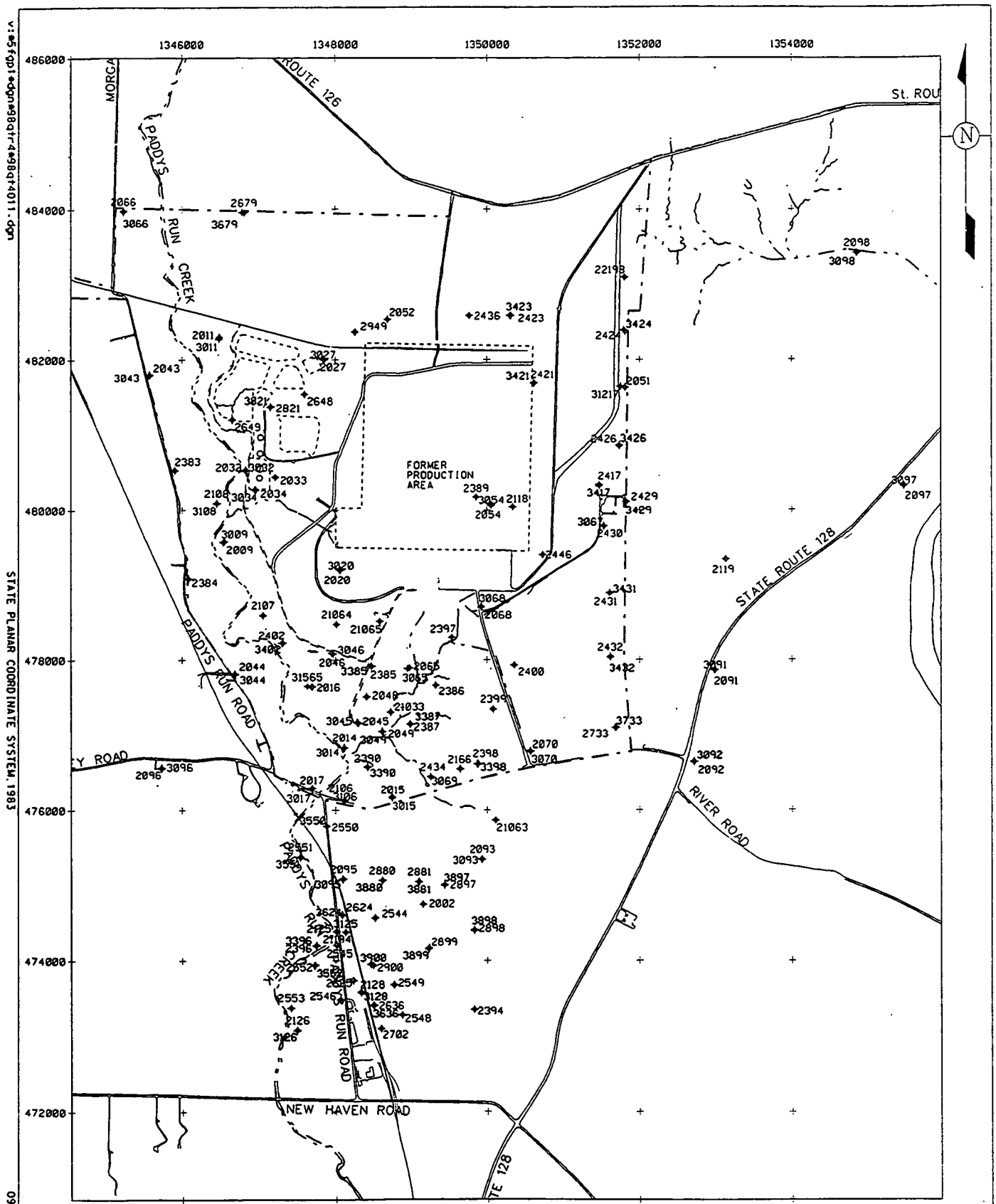
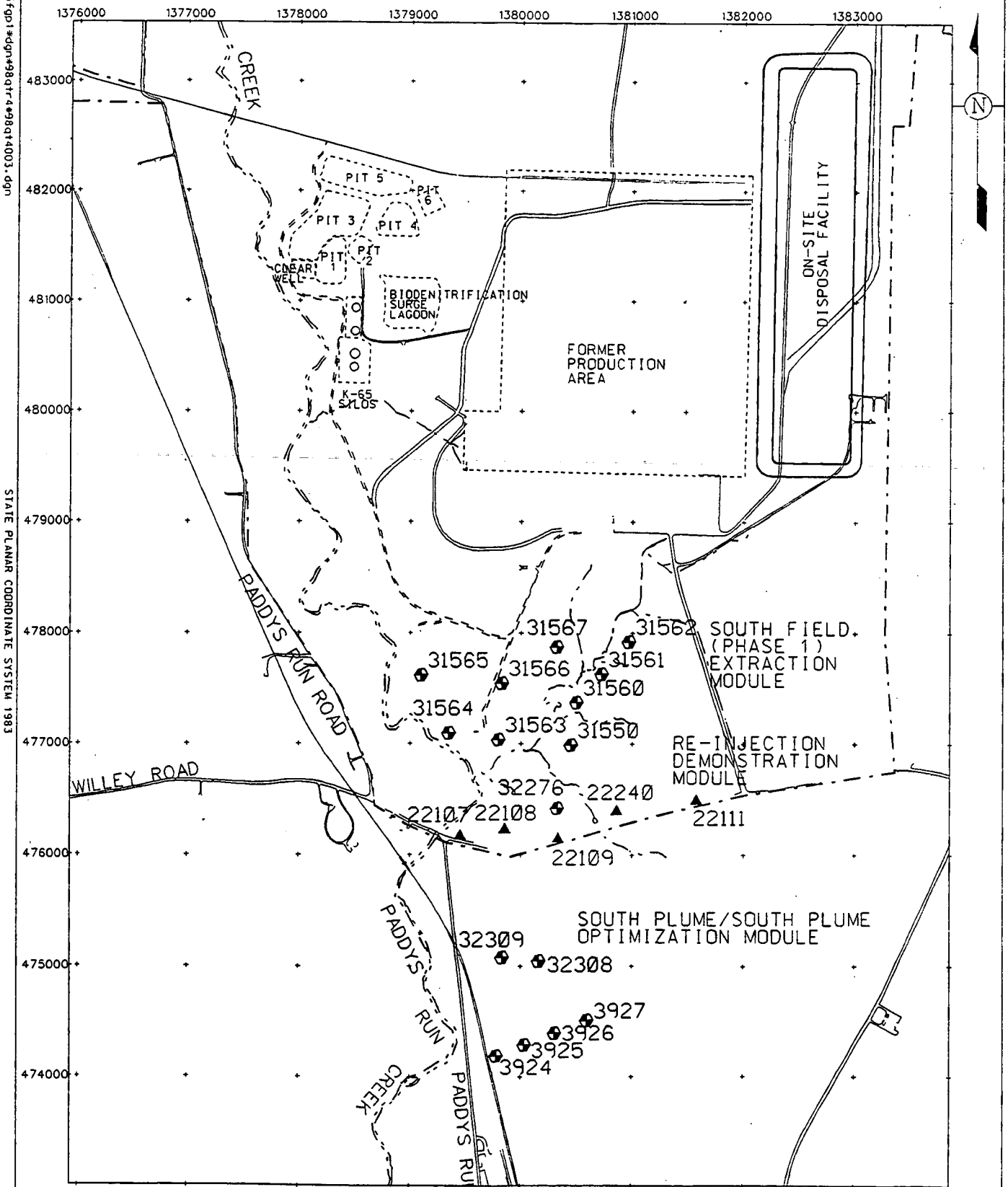


FIGURE 1-3. IEMP GROUNDWATER ELEVATION MONITORING WELLS FOR 1997 AND 1998



v:\5fgp1\dgn\98qtr4\98qt4003.dgn

STATE PLANAR COORDINATE SYSTEM 1983

19-MAR-1999

FIGURE 1-4. LOCATION OF ACTIVE AQUIFER RESTORATION MODULES

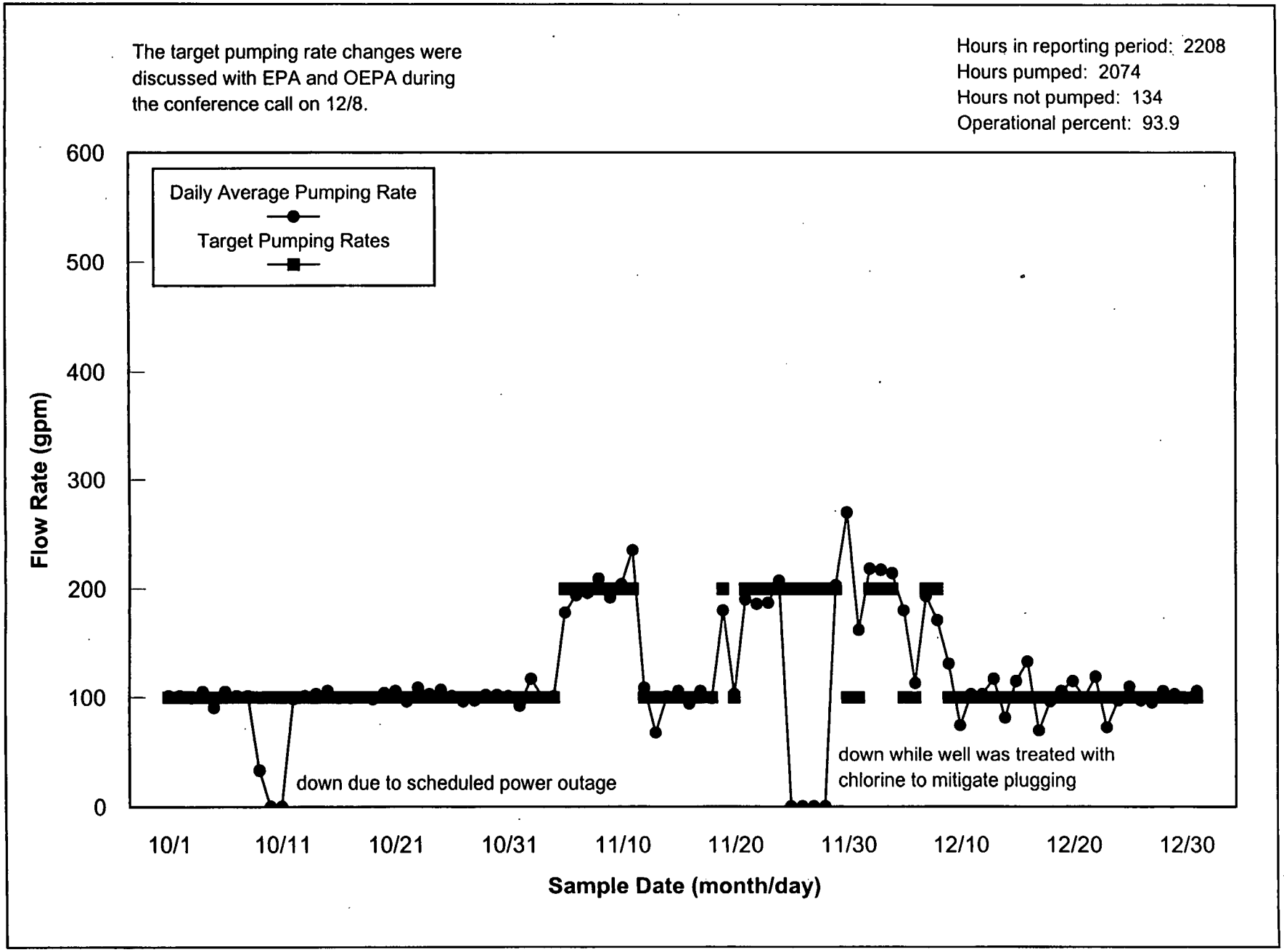


FIGURE 1-5. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31550, 10/98 - 12/98

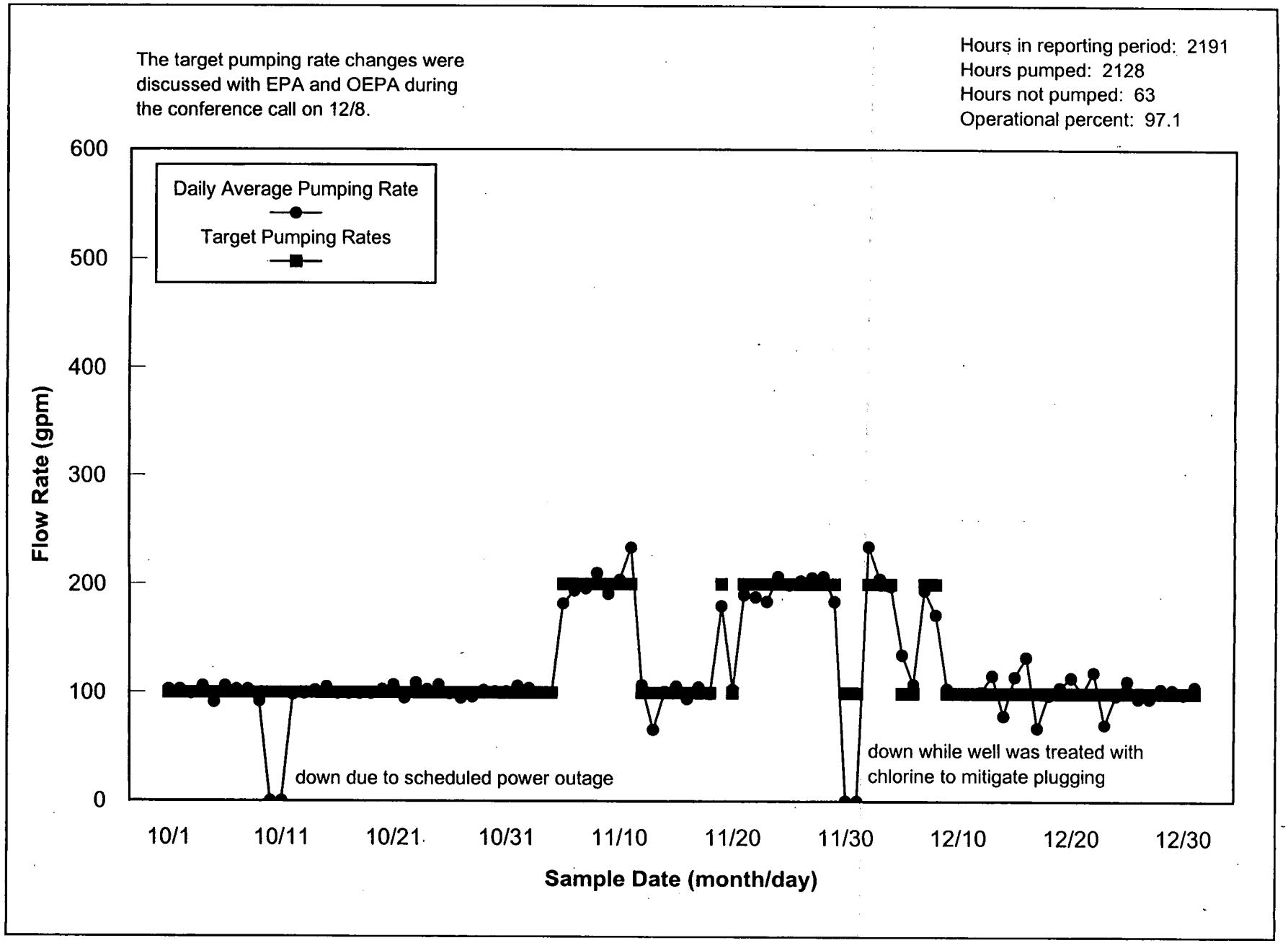


FIGURE 1-6. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31560, 10/98 - 12/98

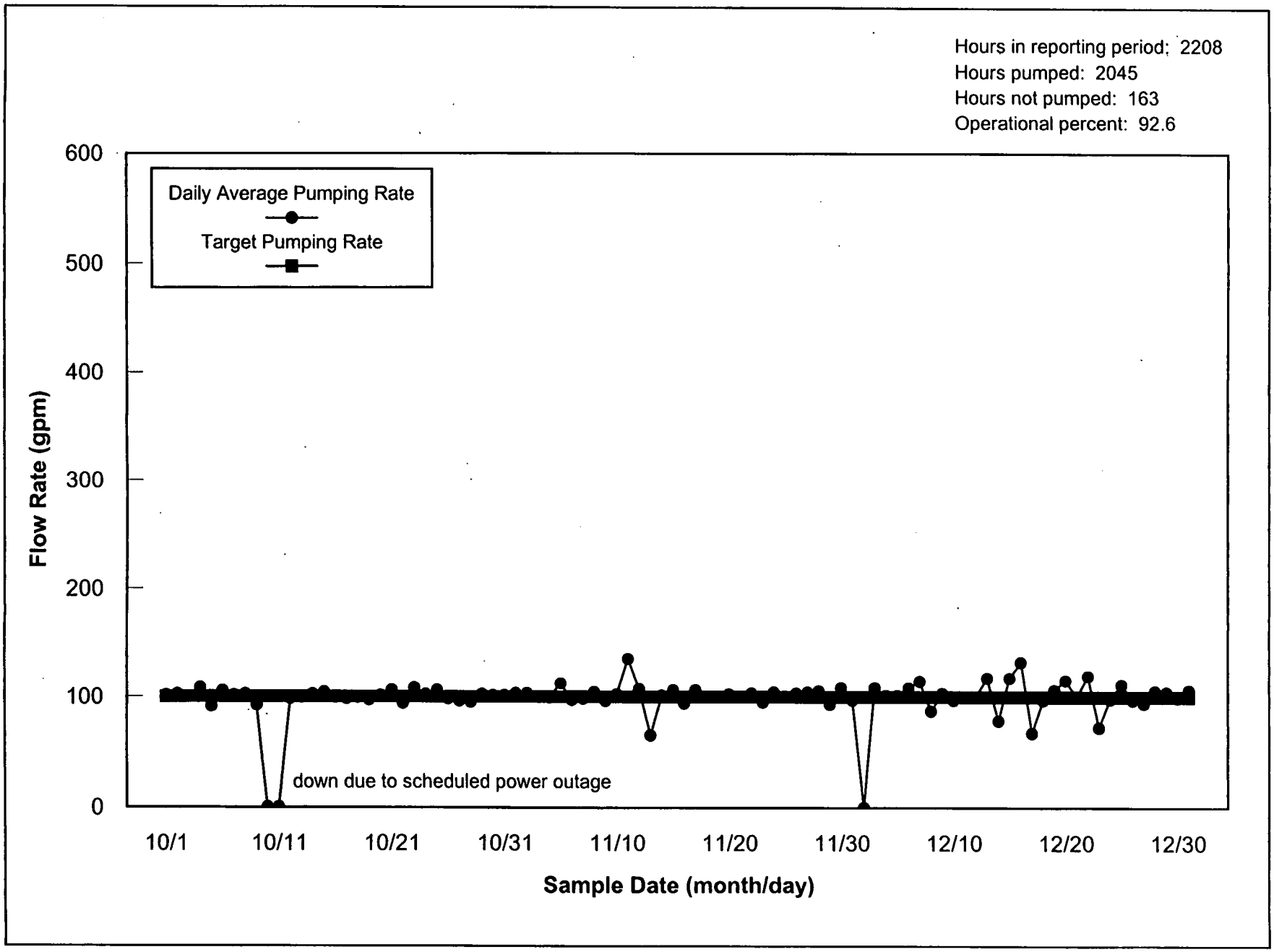


FIGURE 1-7. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31561, 10/98 - 12/98

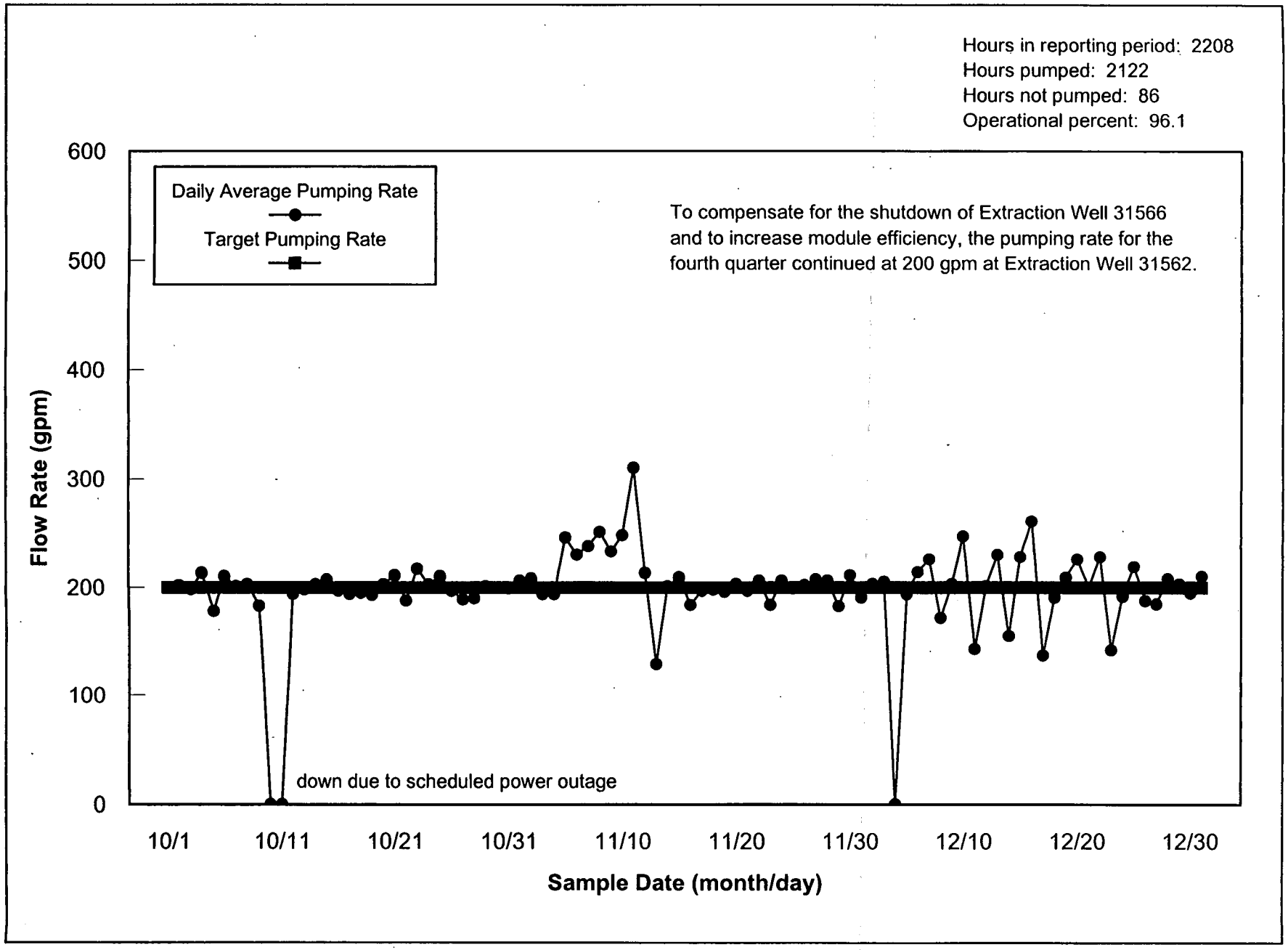


FIGURE 1-8. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31562, 10/98 - 12/98

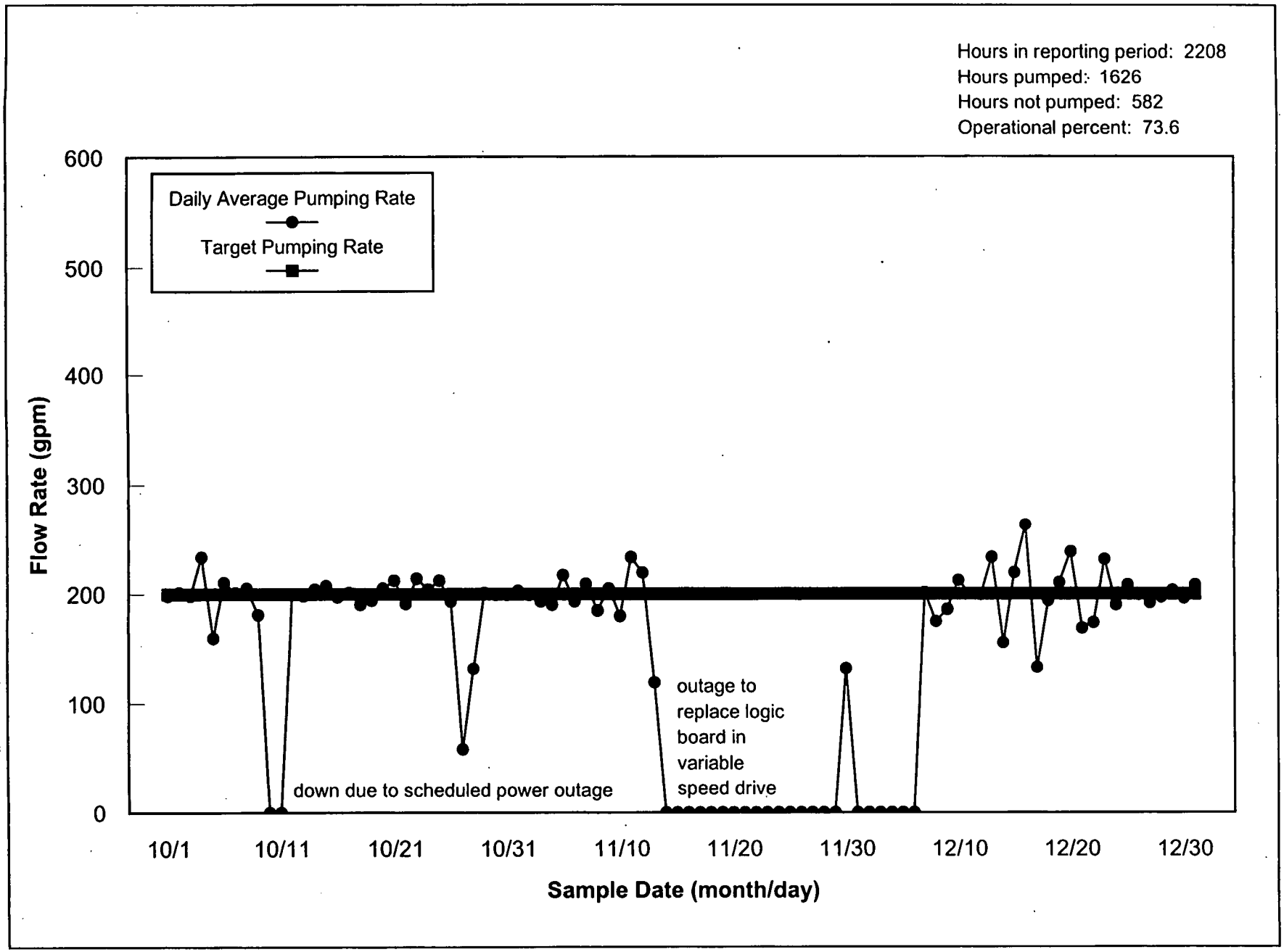


FIGURE 1-9. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31563, 10/98 - 12/98

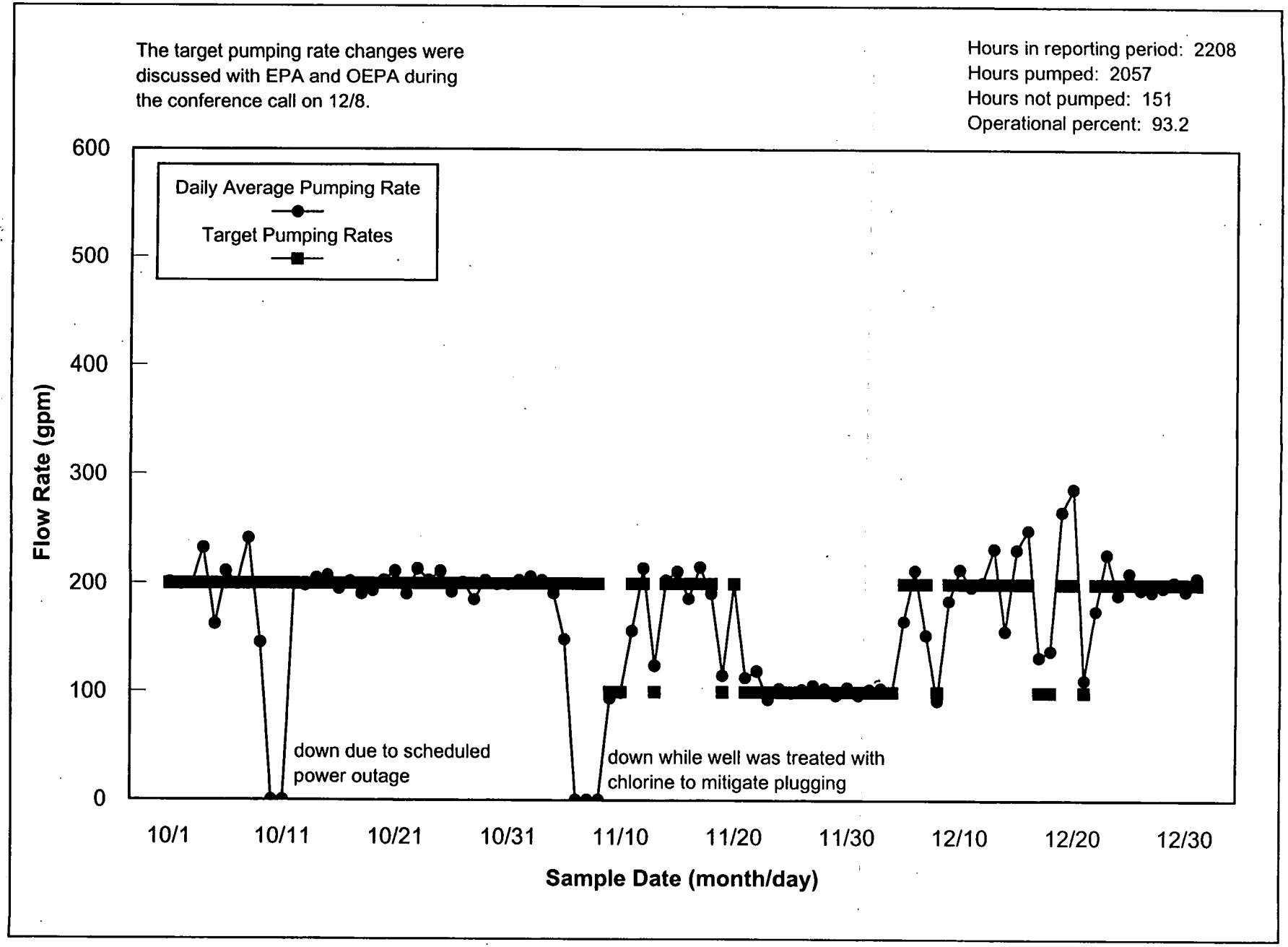


FIGURE 1-10. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31564, 10/98 - 12/98

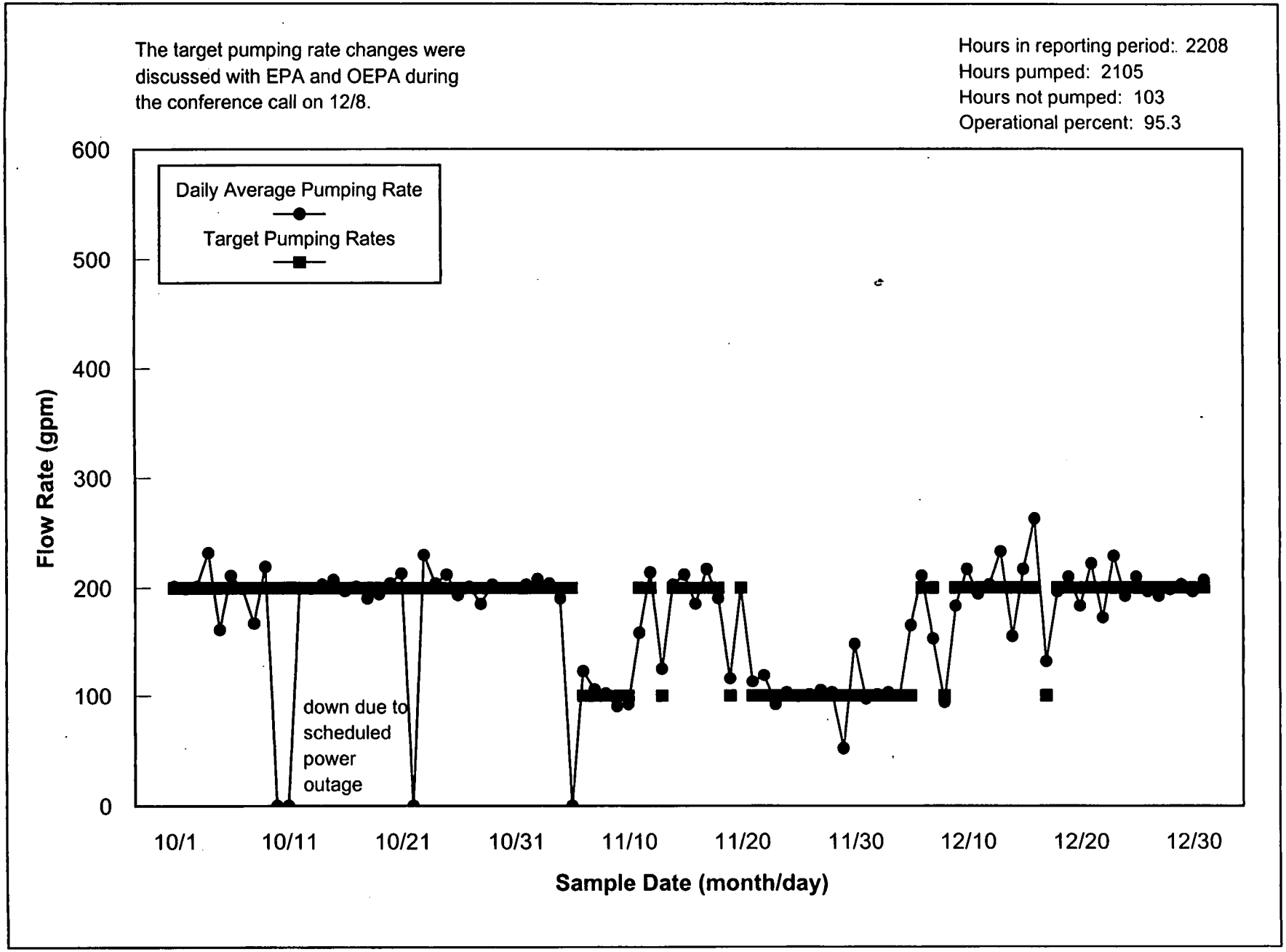


FIGURE 1-11. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31565, 10/98 - 12/98

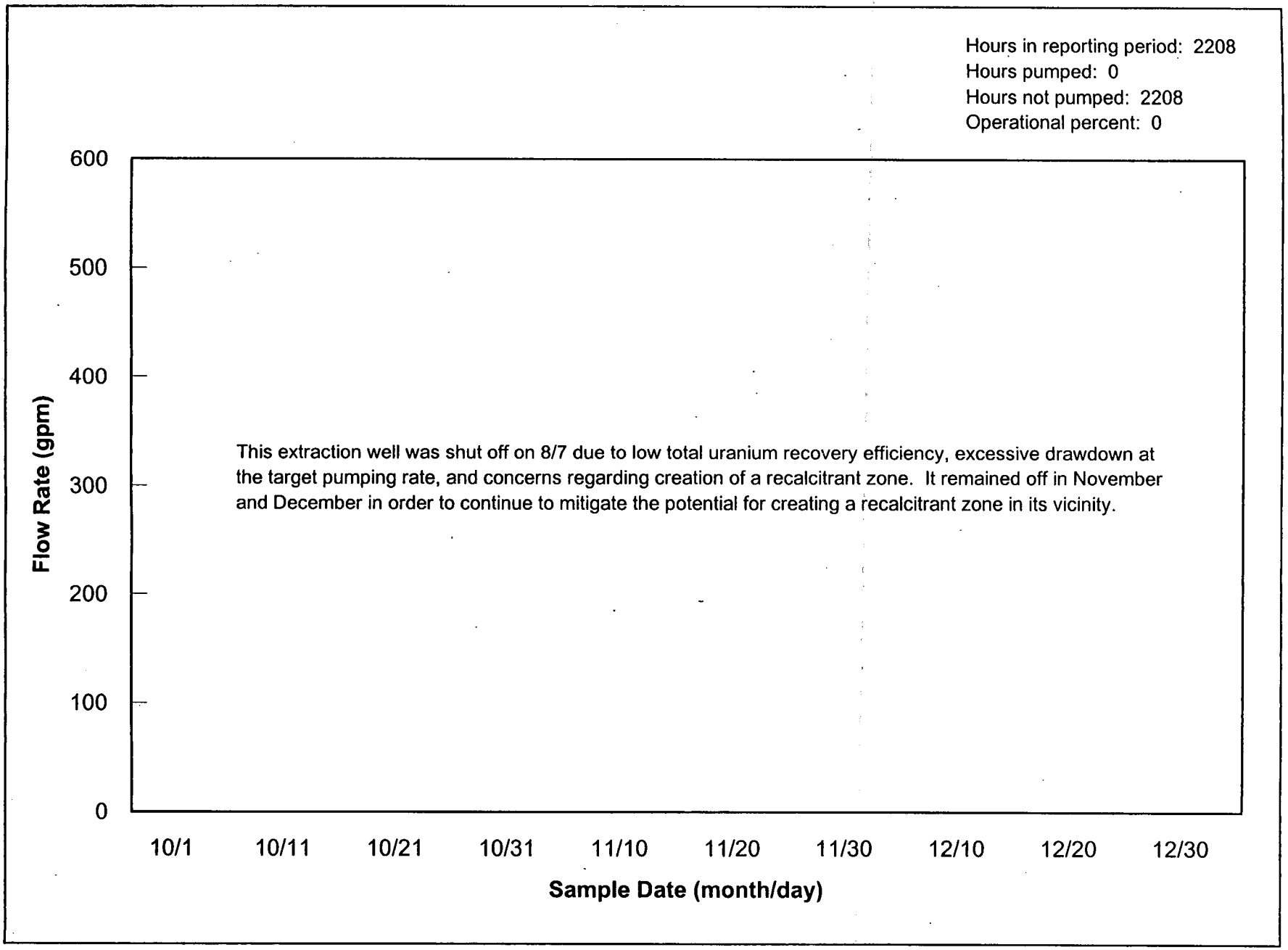


FIGURE 1-12. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31566, 10/98 - 12/98

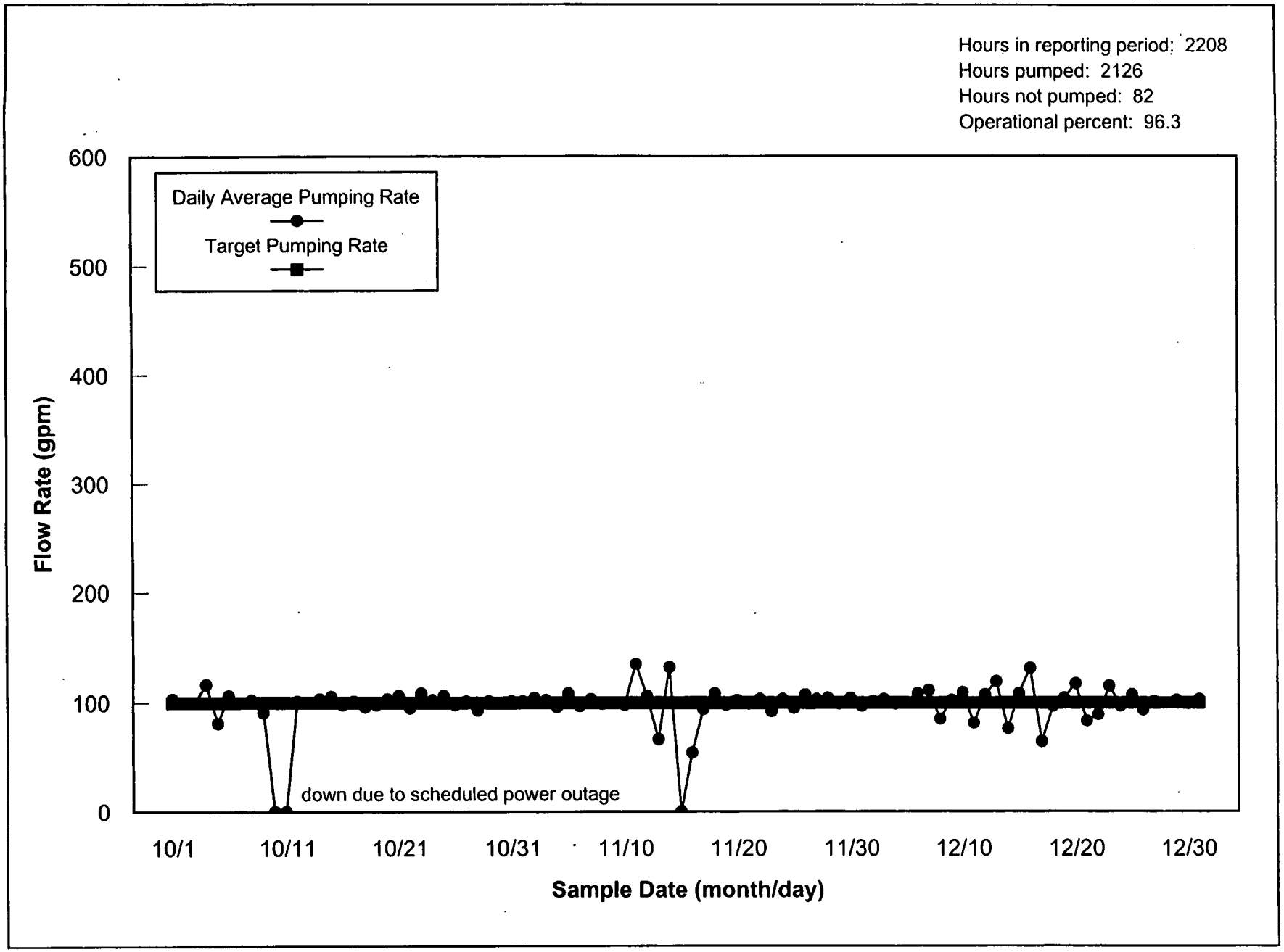


FIGURE 1-13. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 31567, 10/98 - 12/98

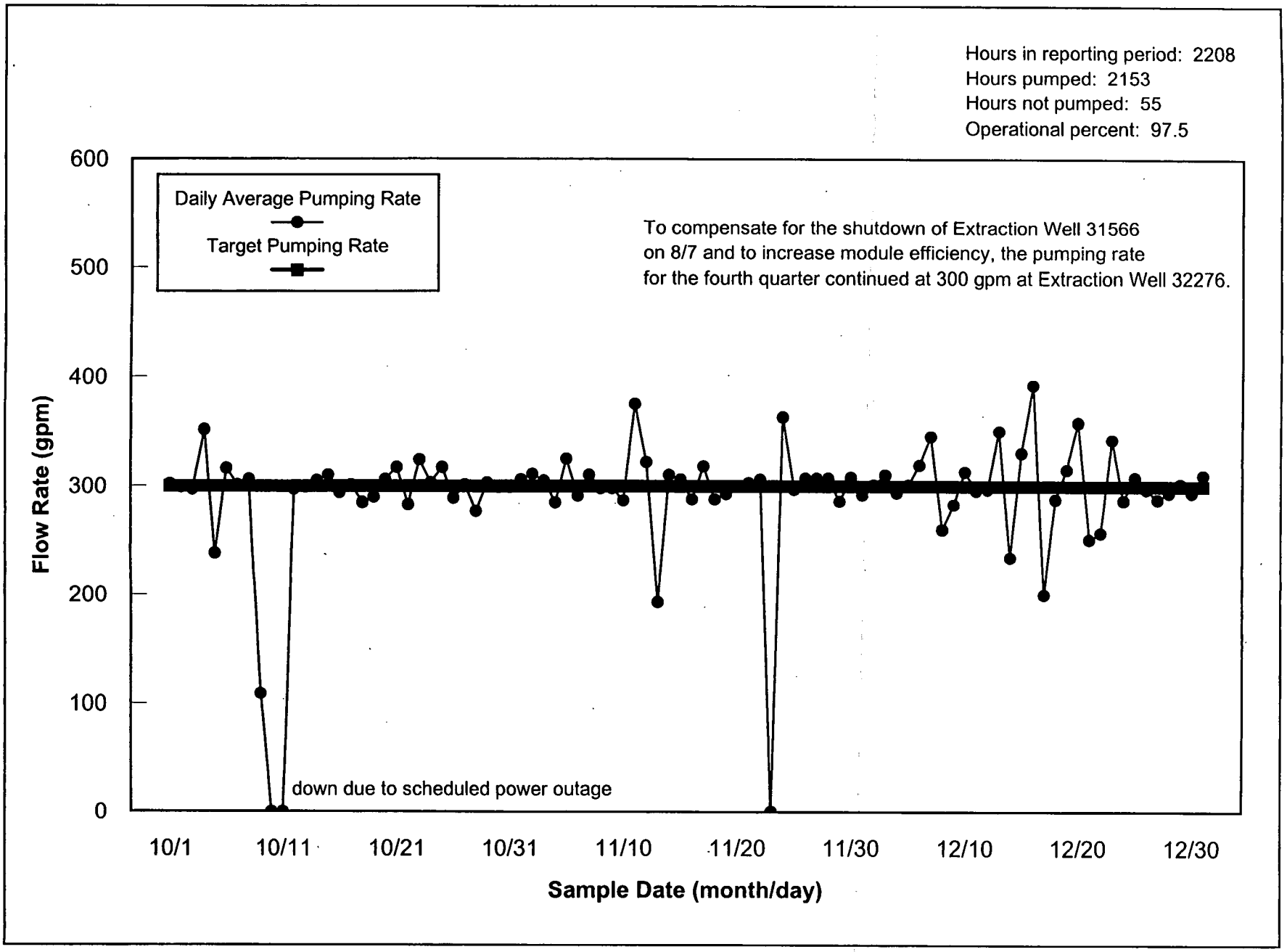


FIGURE 1-14. DAILY AVERAGE PUMPING RATES FOR SOUTH FIELD (PHASE 1) EXTRACTION WELL 32276, 10/98 - 12/98

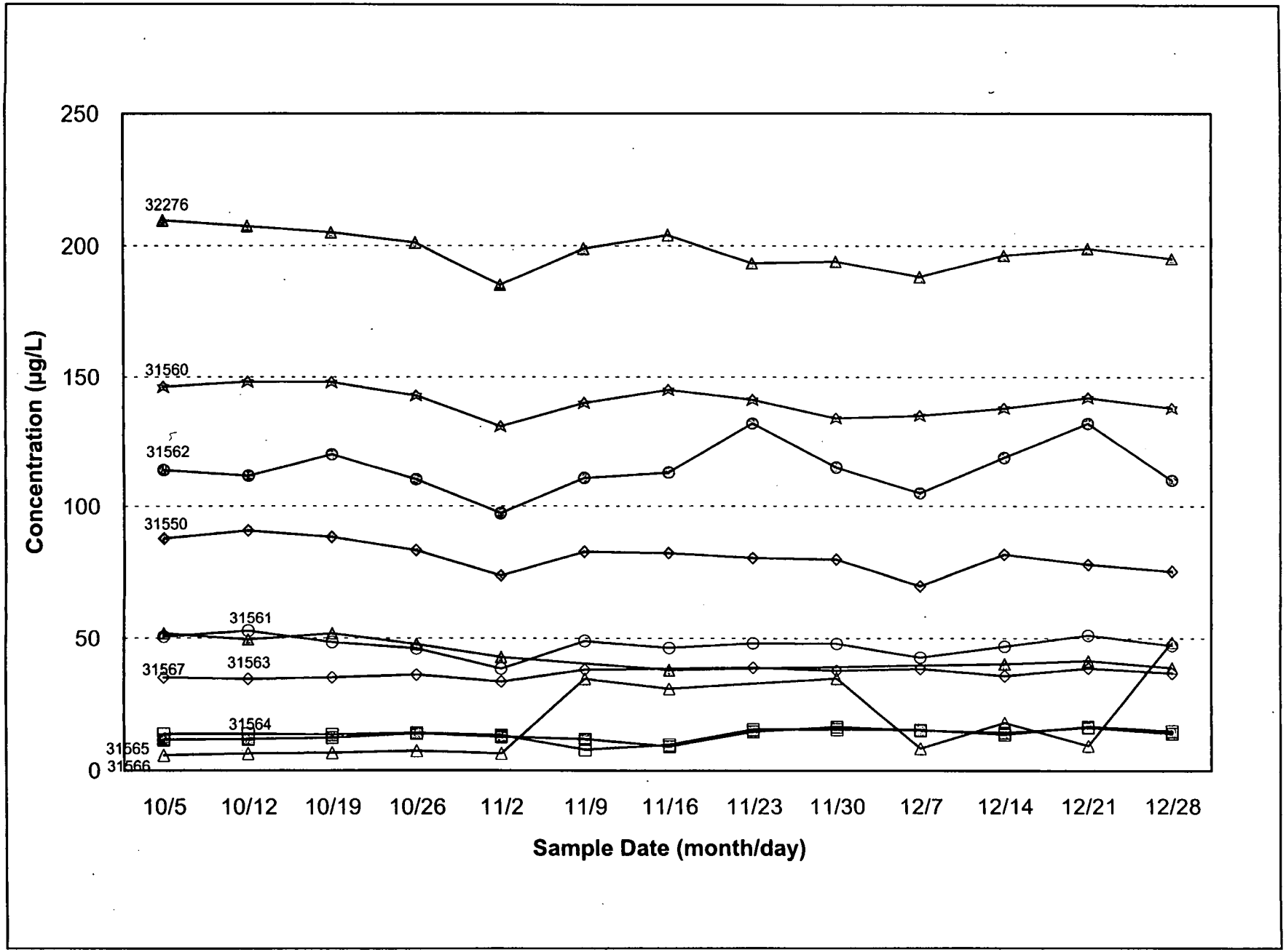


FIGURE 1-15. WEEKLY AVERAGE TOTAL URANIUM CONCENTRATIONS FOR THE SOUTH FIELD (PHASE 1) EXTRACTION MODULE

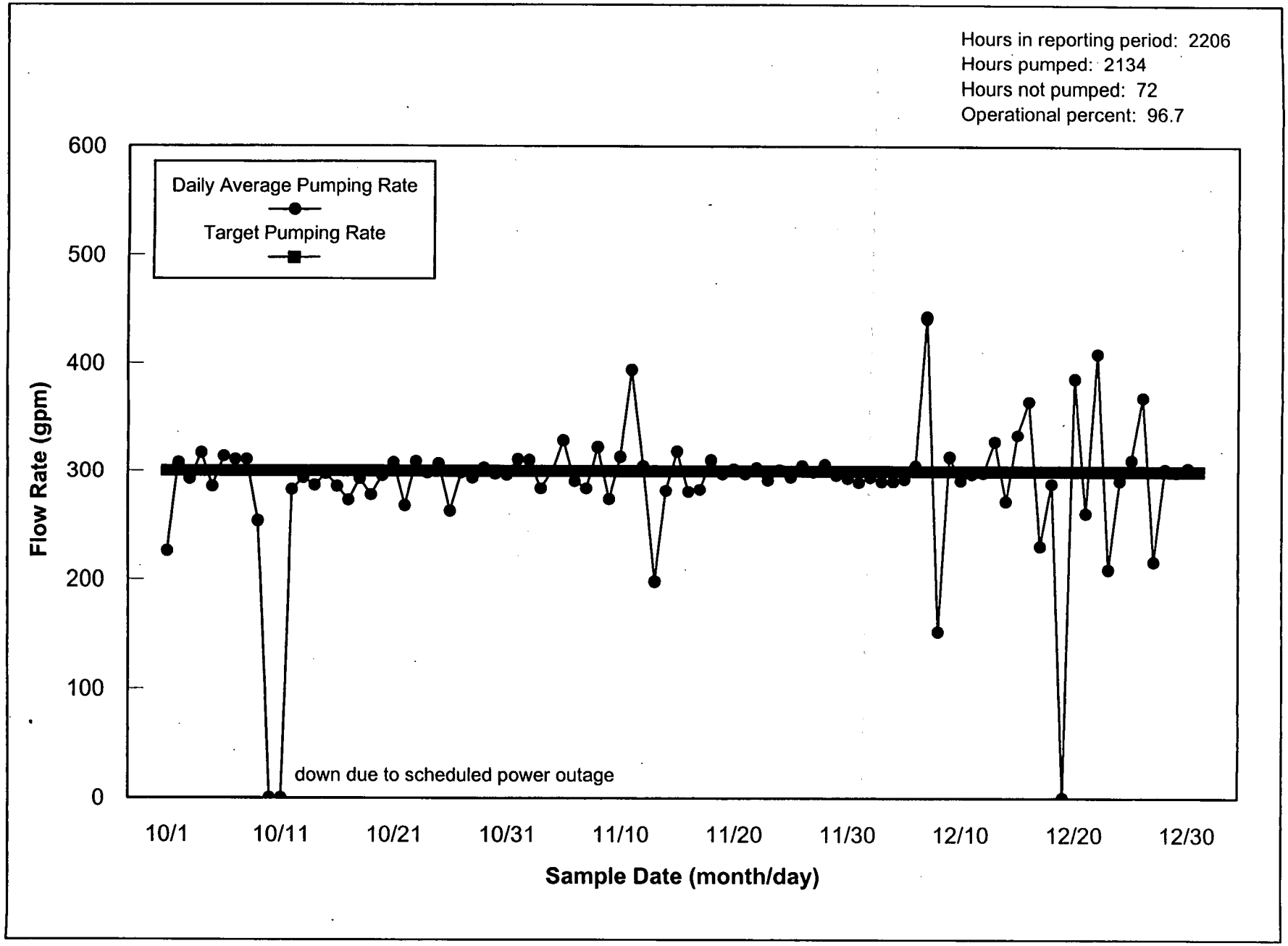


FIGURE 1-16. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 3924, 10/98 - 12/98

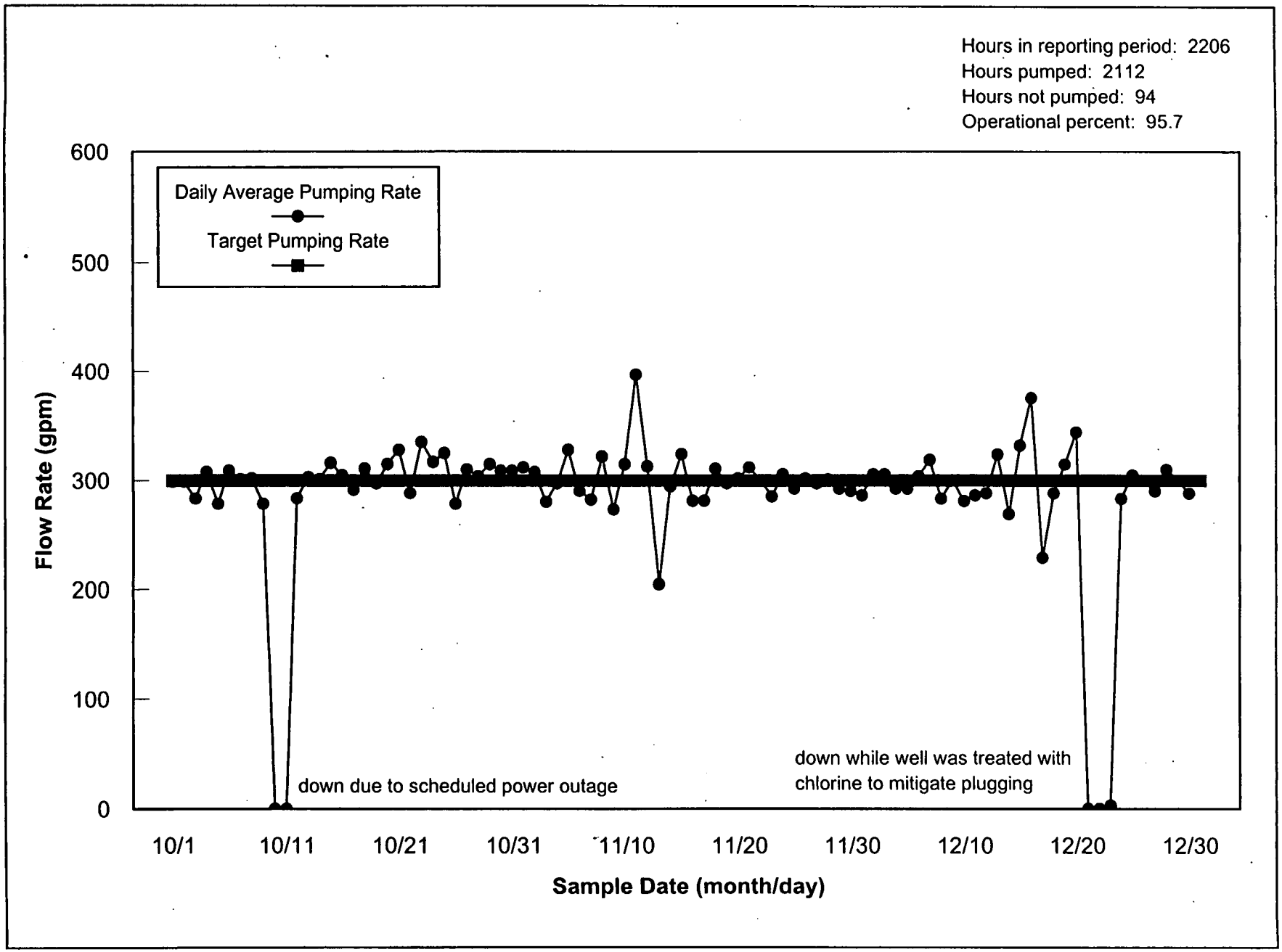


FIGURE 1-17. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 3925, 10/98 - 12/98

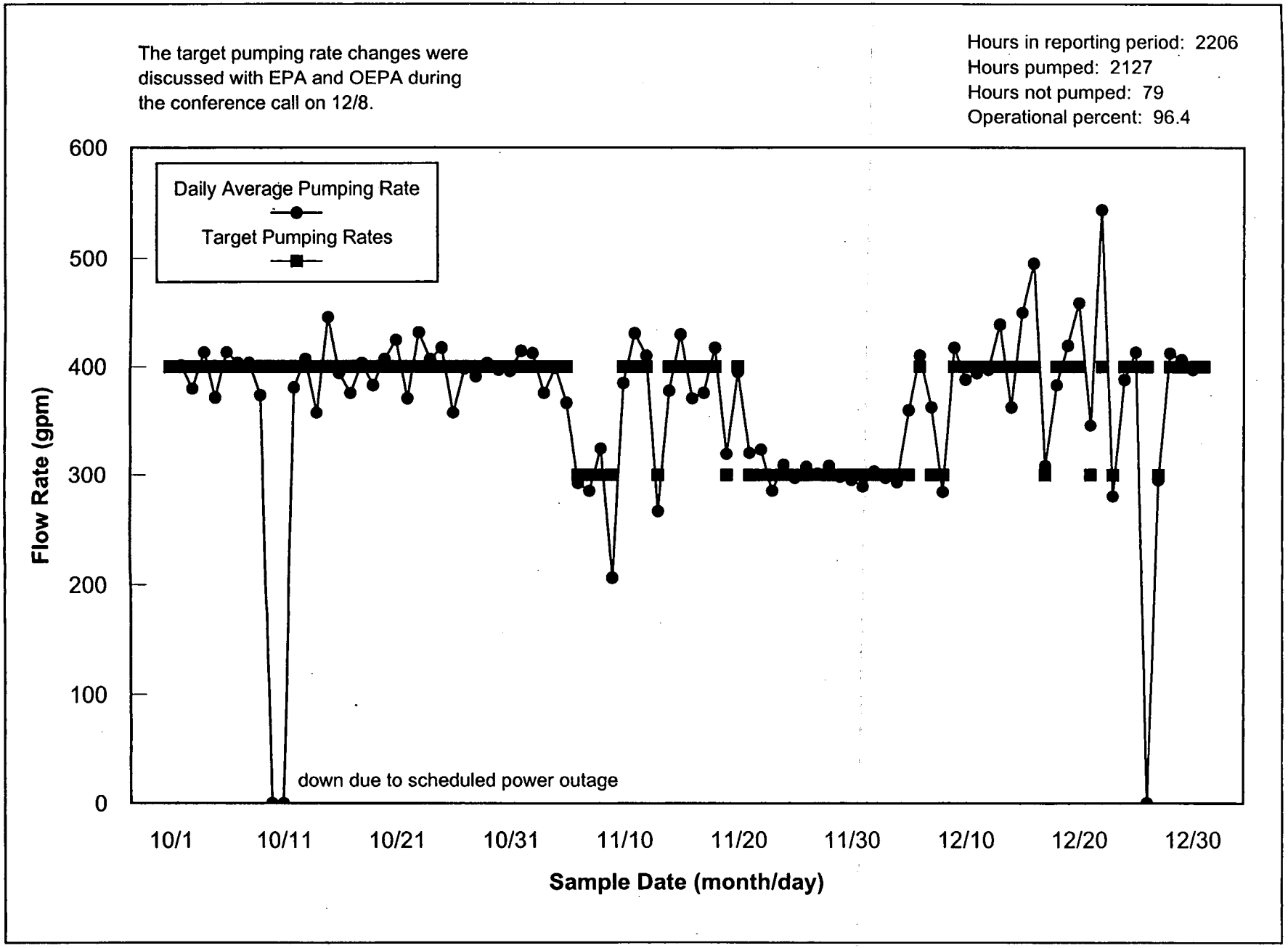


FIGURE 1-18. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 3926, 10/98 - 12/98

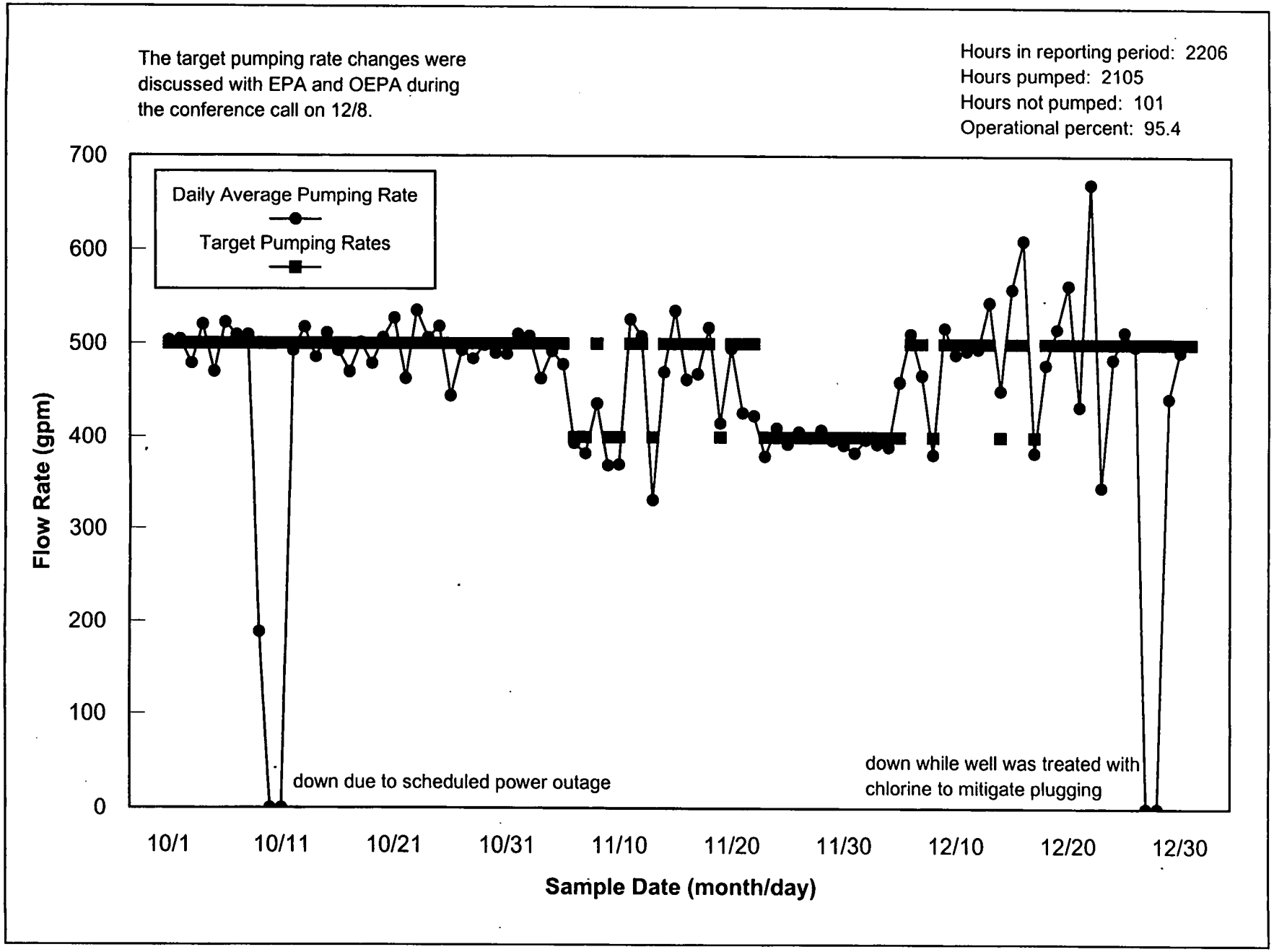


FIGURE 1-19. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 3927, 10/98 - 12/98

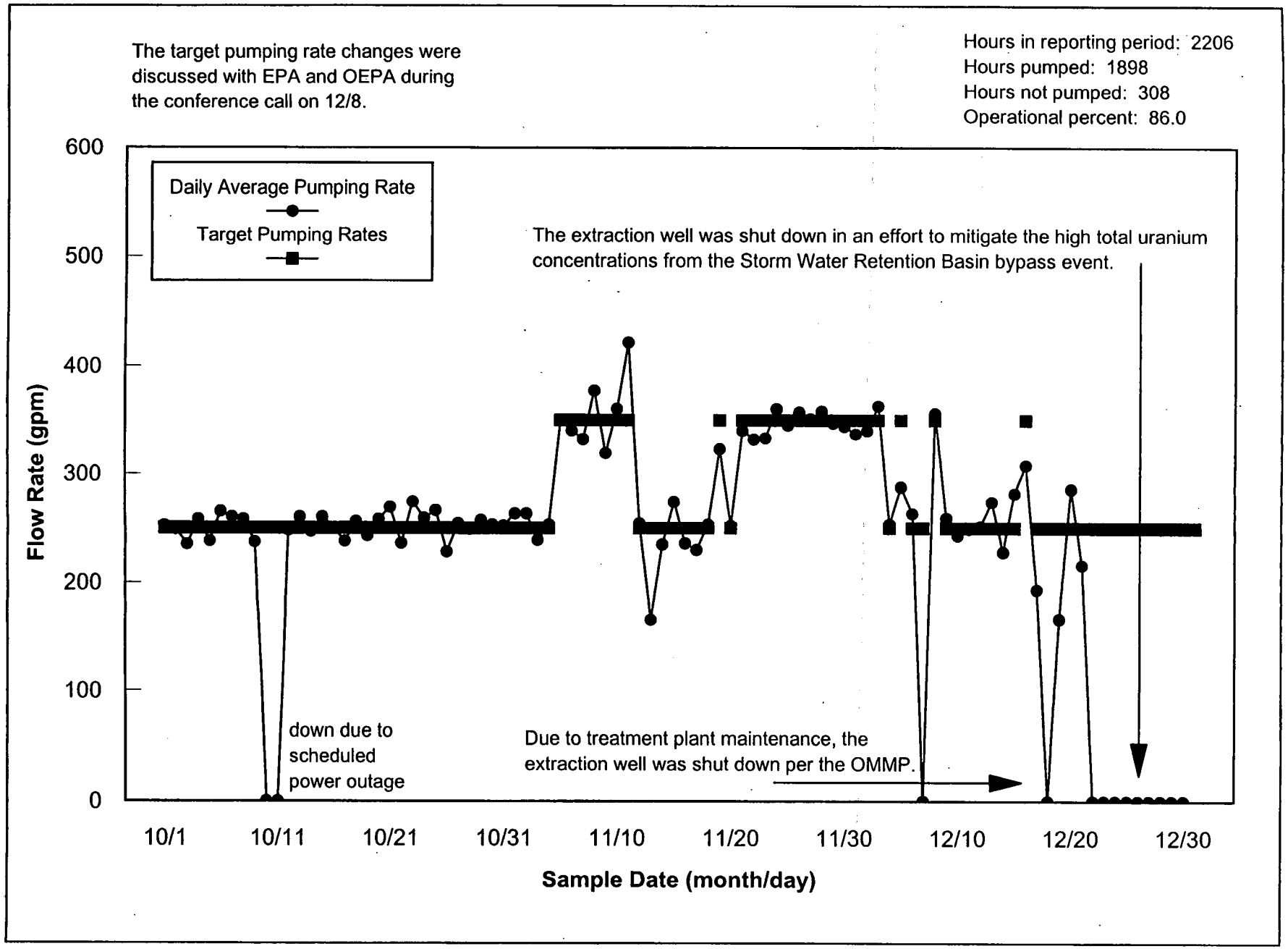


FIGURE 1-20. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 32308, 10/98 - 12/98

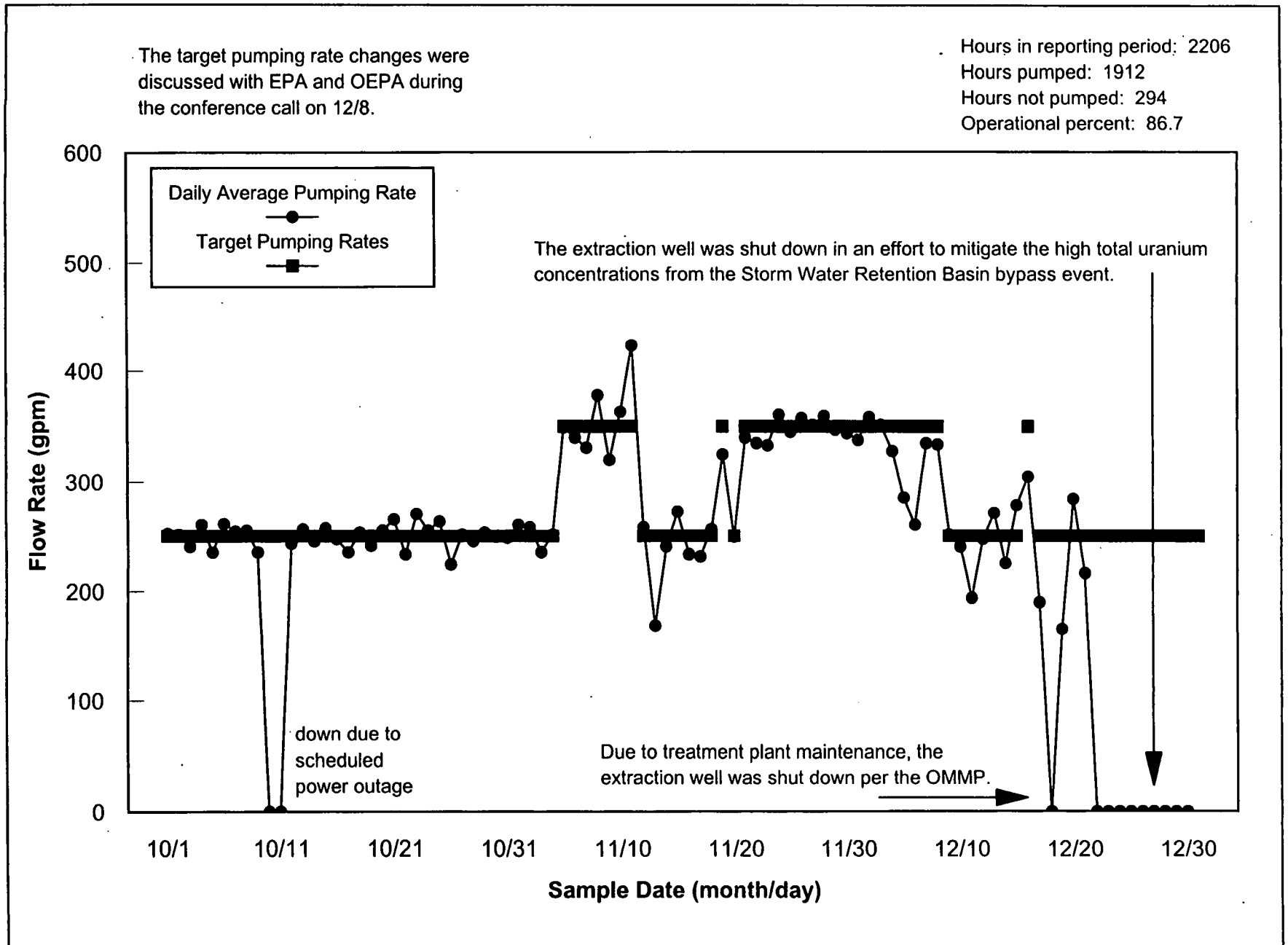


FIGURE 1-21. DAILY AVERAGE PUMPING RATES FOR SOUTH PLUME EXTRACTION WELL 32309, 10/98 - 12/98

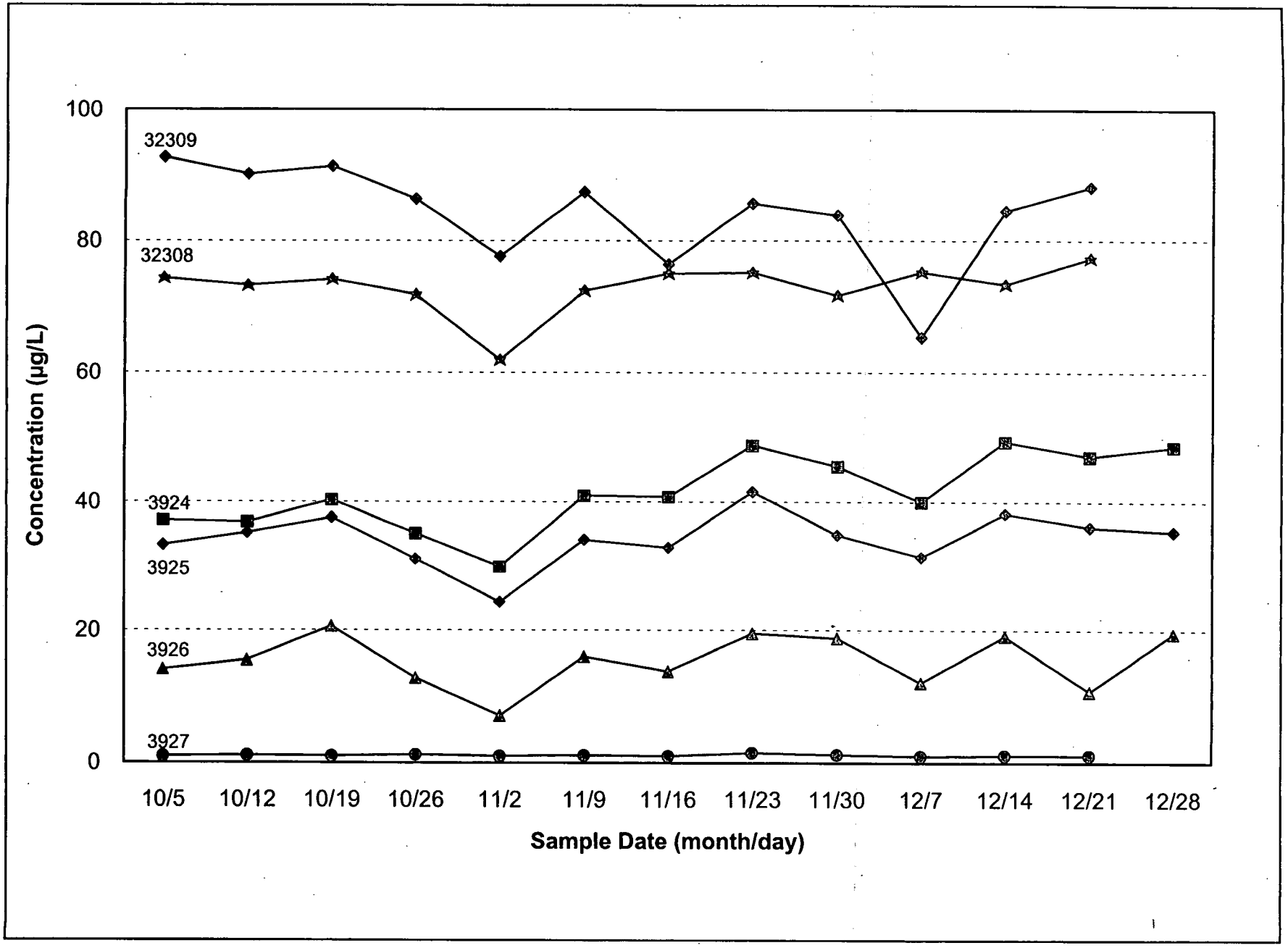


FIGURE 1-22. WEEKLY AVERAGE TOTAL URANIUM CONCENTRATIONS FOR THE SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULE

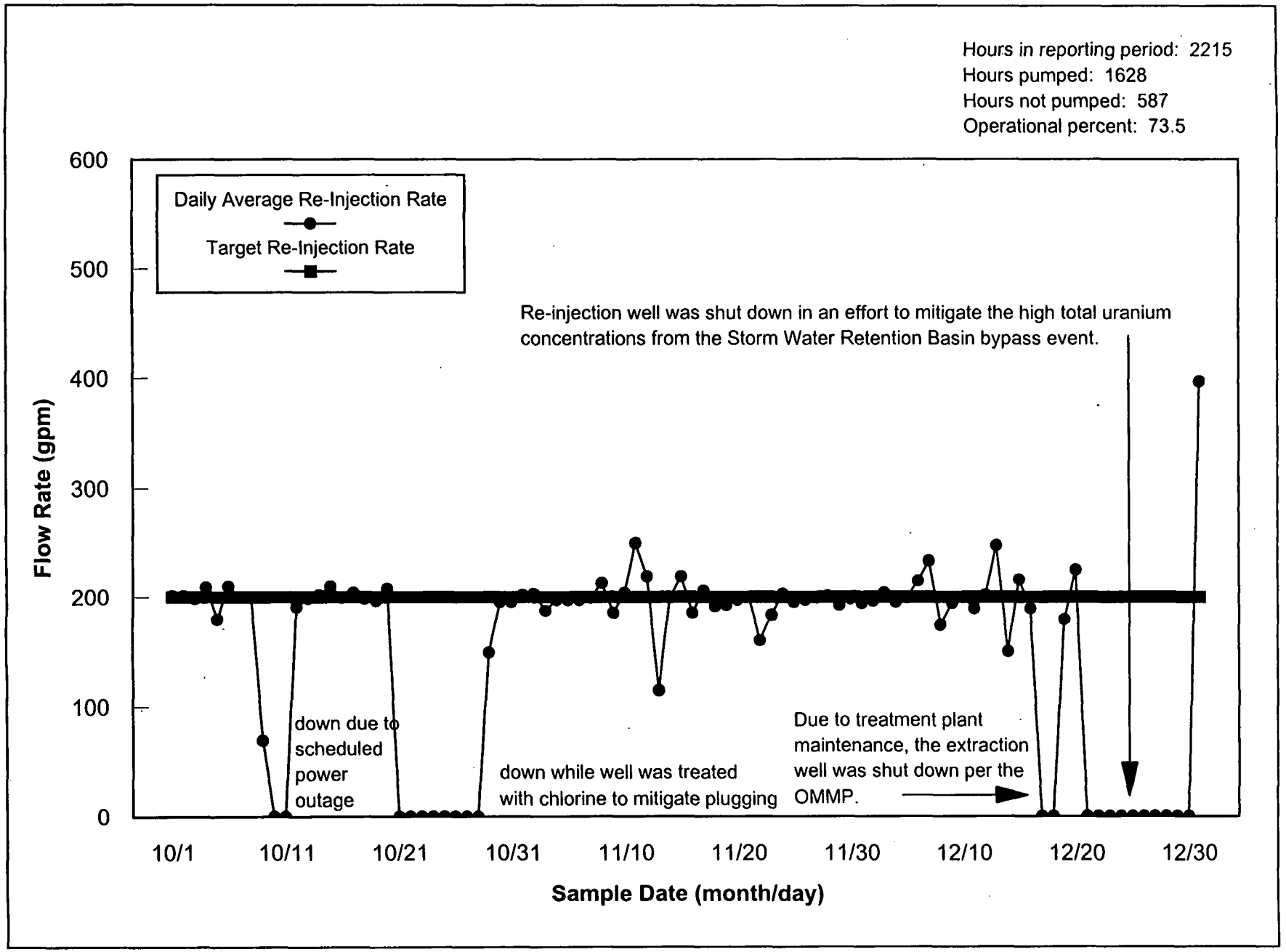


FIGURE 1-23. DAILY AVERAGE RE-INJECTION RATES FOR RE-INJECTION WELL 22107, 10/98 - 12/98

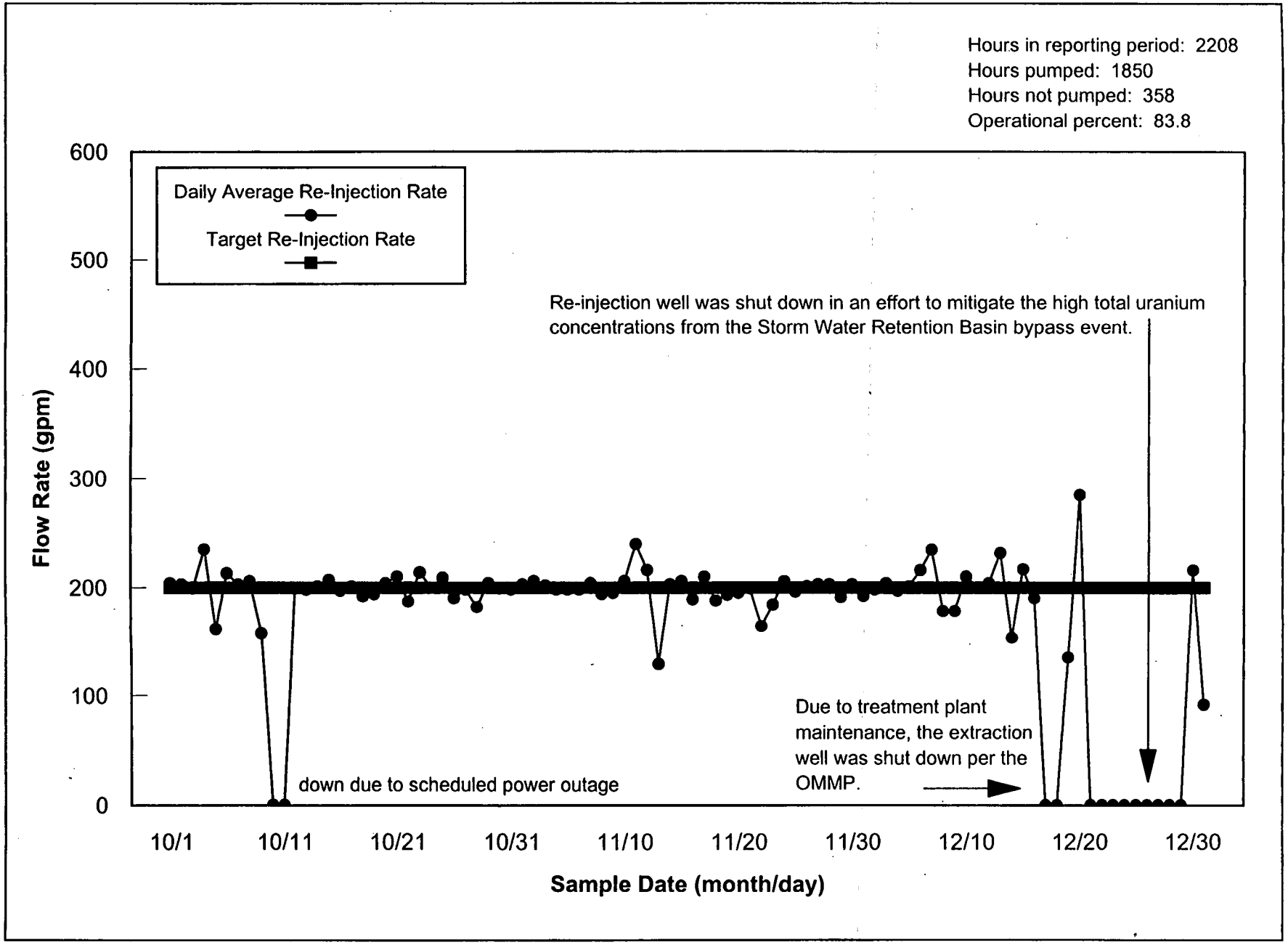


FIGURE 1-24. DAILY AVERAGE RE-INJECTION RATES FOR RE-INJECTION WELL 22108, 10/98 - 12/98

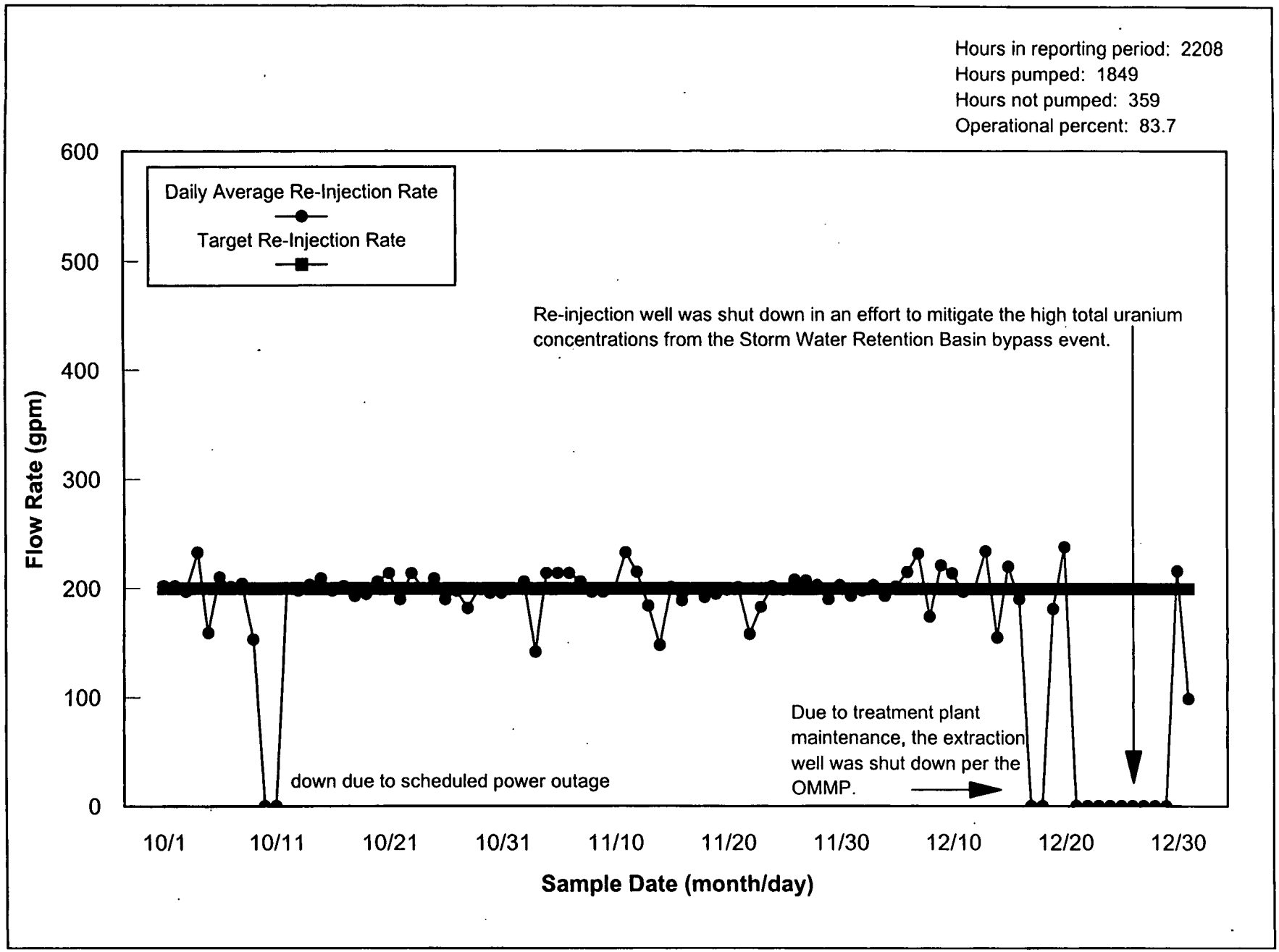


FIGURE 1-25. DAILY AVERAGE RE-INJECTION RATES FOR RE-INJECTION WELL 22109, 10/98 - 12/98

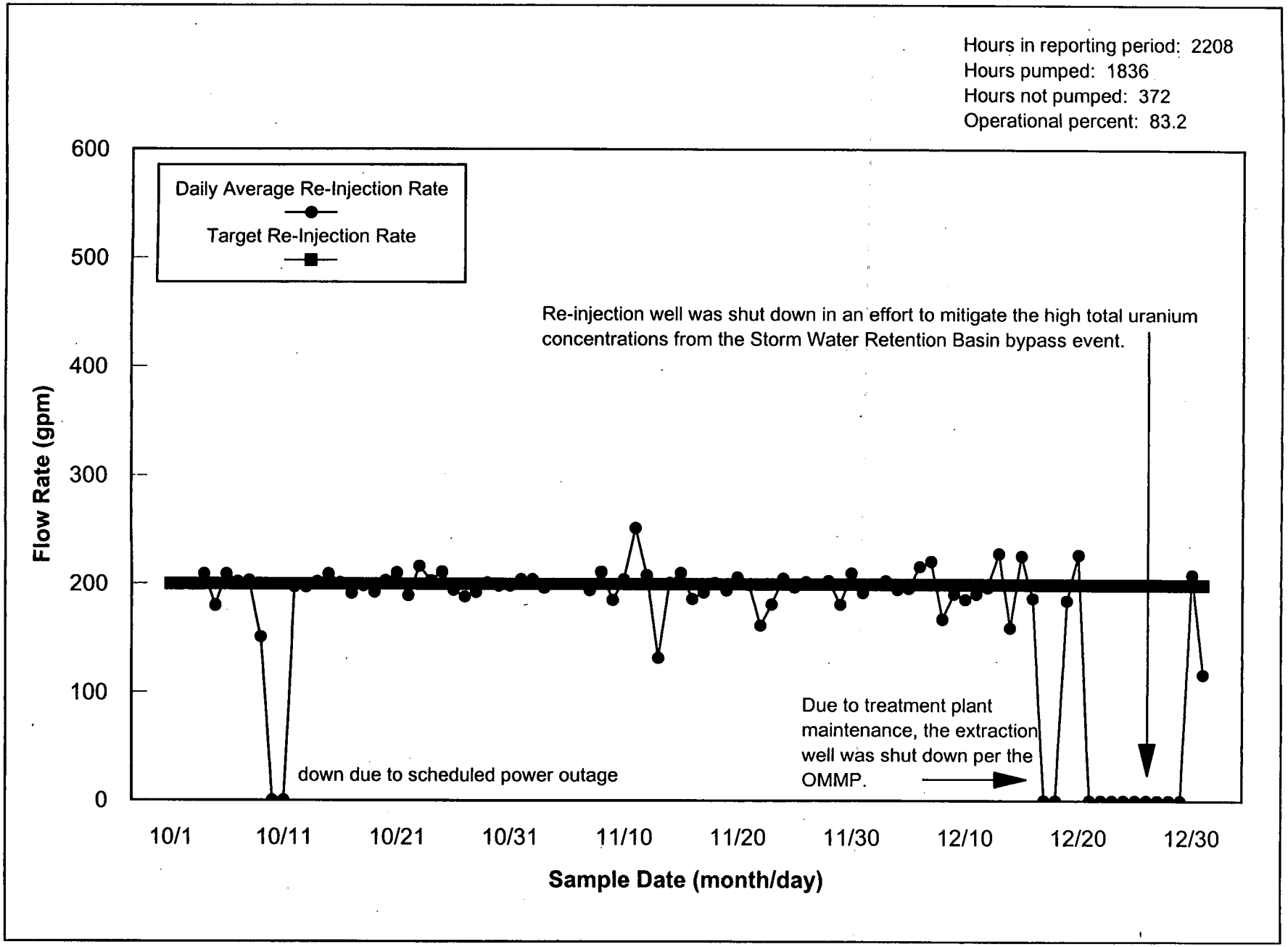


FIGURE 1-26. DAILY AVERAGE RE-INJECTION RATES FOR RE-INJECTION WELL 22111, 10/98 - 12/98

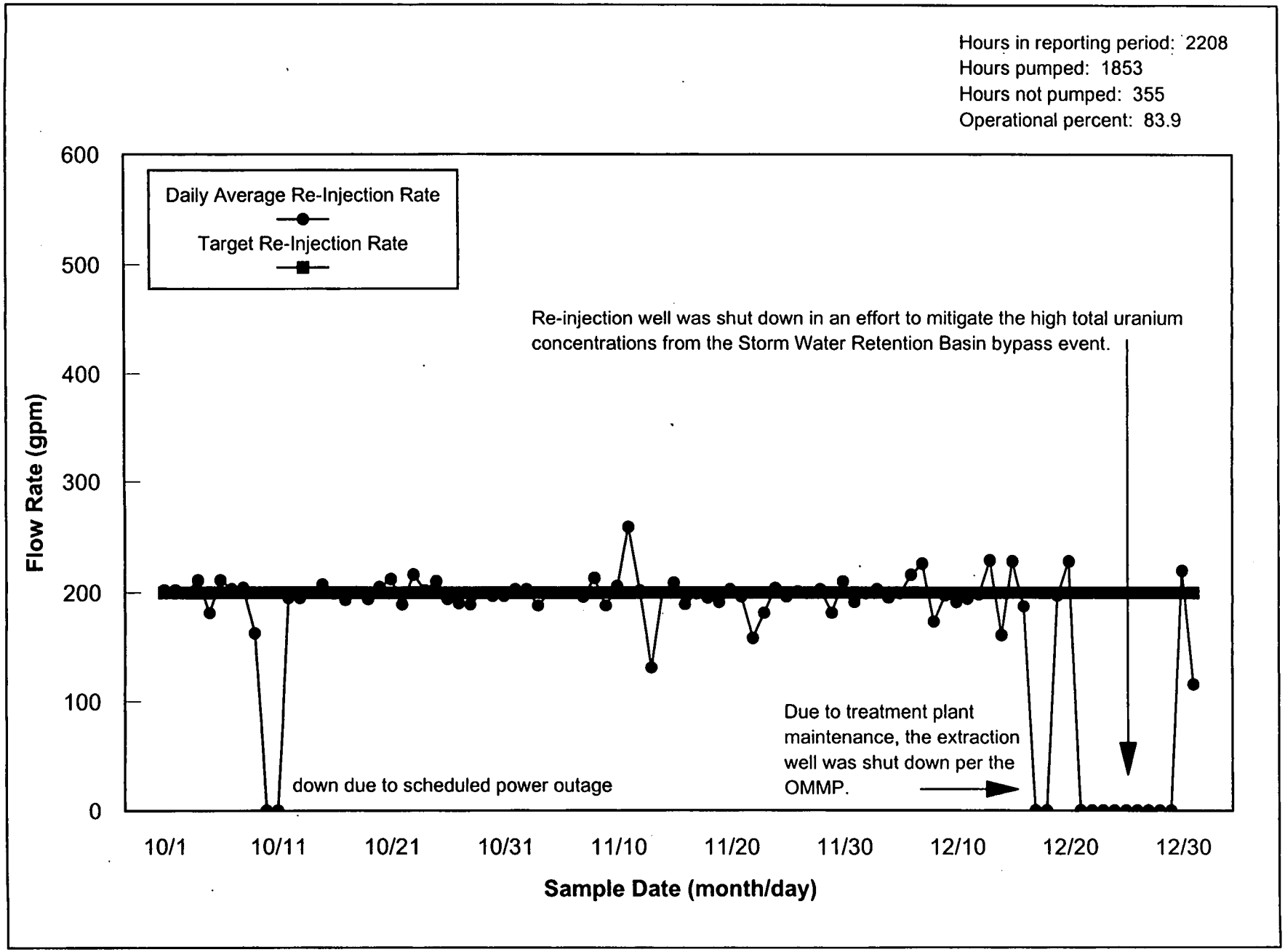


FIGURE 1-27. DAILY AVERAGE RE-INJECTION RATES FOR RE-INJECTION WELL 22240, 10/98 - 12/98

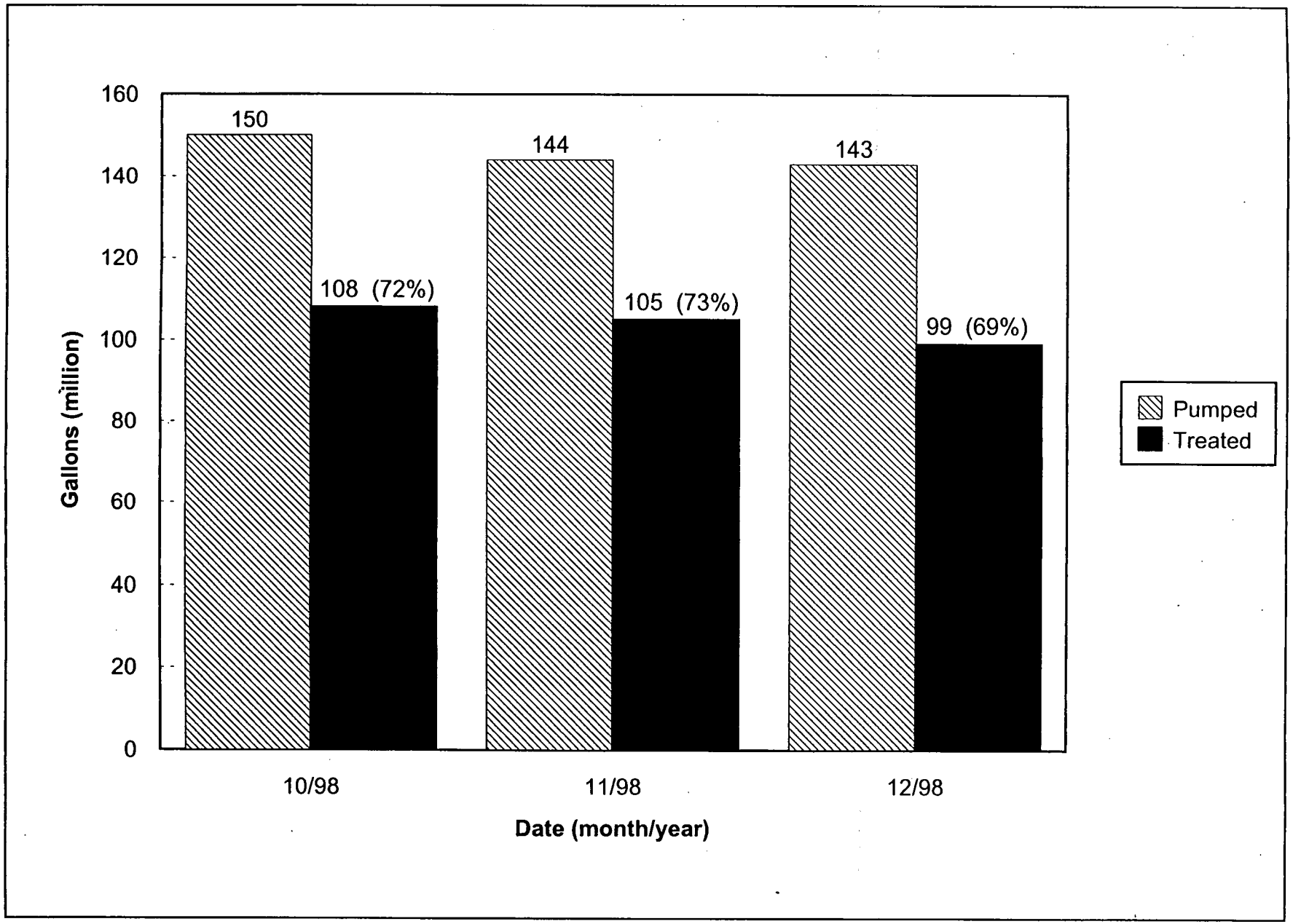
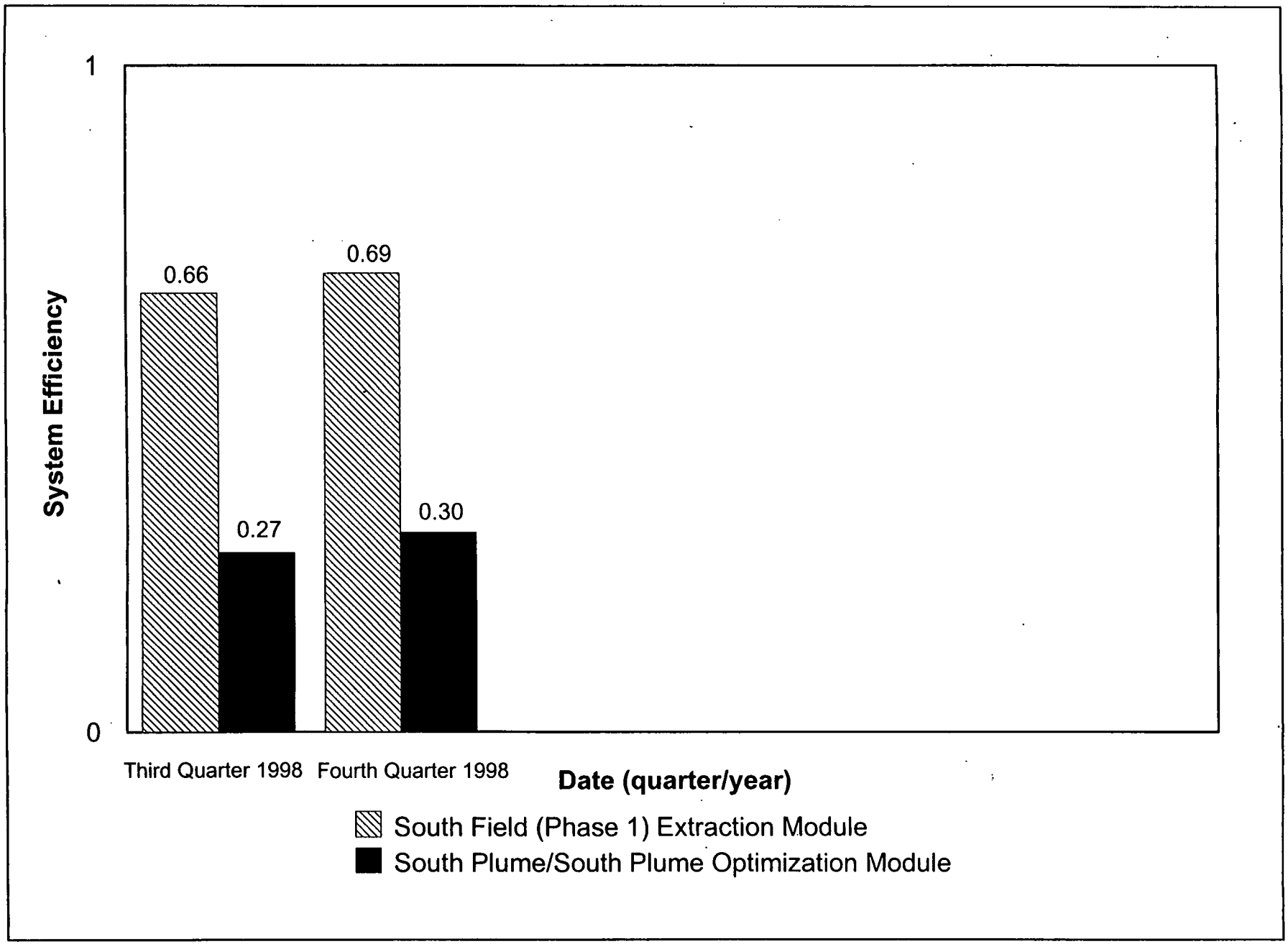
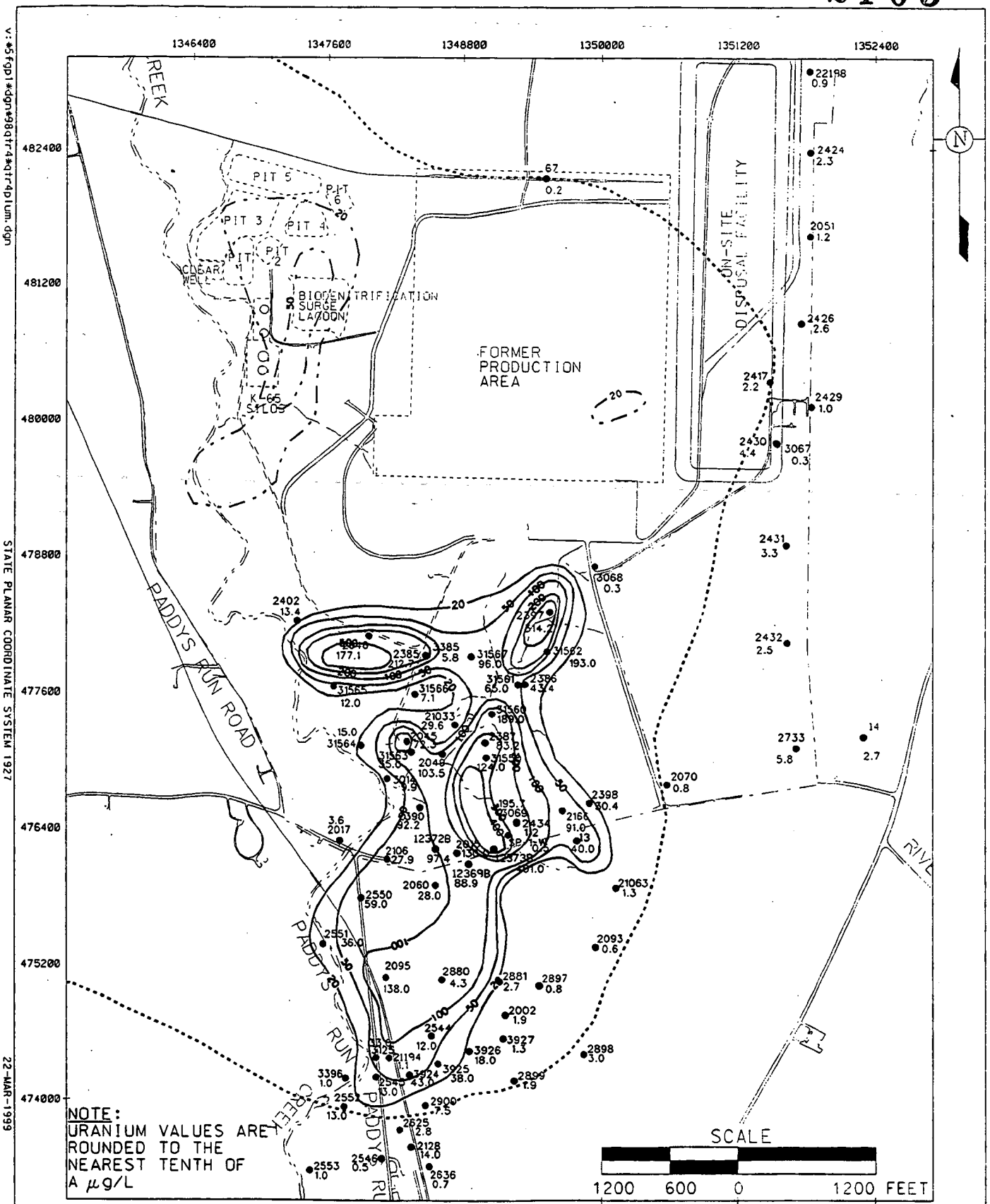


FIGURE 1-28. TOTAL GROUNDWATER PUMPED VS. GROUNDWATER TREATED FOR FOURTH QUARTER 1998



650000

FIGURE 1-29. SOUTH FIELD (PHASE 1) EXTRACTION AND SOUTH PLUME/SOUTH PLUME OPTIMIZATION MODULES' EFFICIENCIES (LBS OF URANIUM REMOVED/MILLION GALLONS PUMPED)



NOTE:
URANIUM VALUES ARE ROUNDED TO THE NEAREST TENTH OF A $\mu g/L$

LEGEND:

- 2553● MONITORING WELL LOCATION
- 5.1 MAXIMUM URANIUM CONCENTRATION UPDATED THROUGH THIRD QUARTER 1998
- PLUME SEGMENT FROM SECOND QUARTER STATUS REPORT
- FEMP BOUNDARY
- TOTAL URANIUM CONTOUR IN $\mu g/L$
- 10-YEAR, URANIUM-BASED RESTORATION FOOTPRINT

FIGURE 1-30. TOTAL URANIUM PLUME MAP

000060

v:\5fgp1\dgn\98qtr4\qtr4plum.dgn
STATE PLANAR COORDINATE SYSTEM 1927
22-MAR-1999

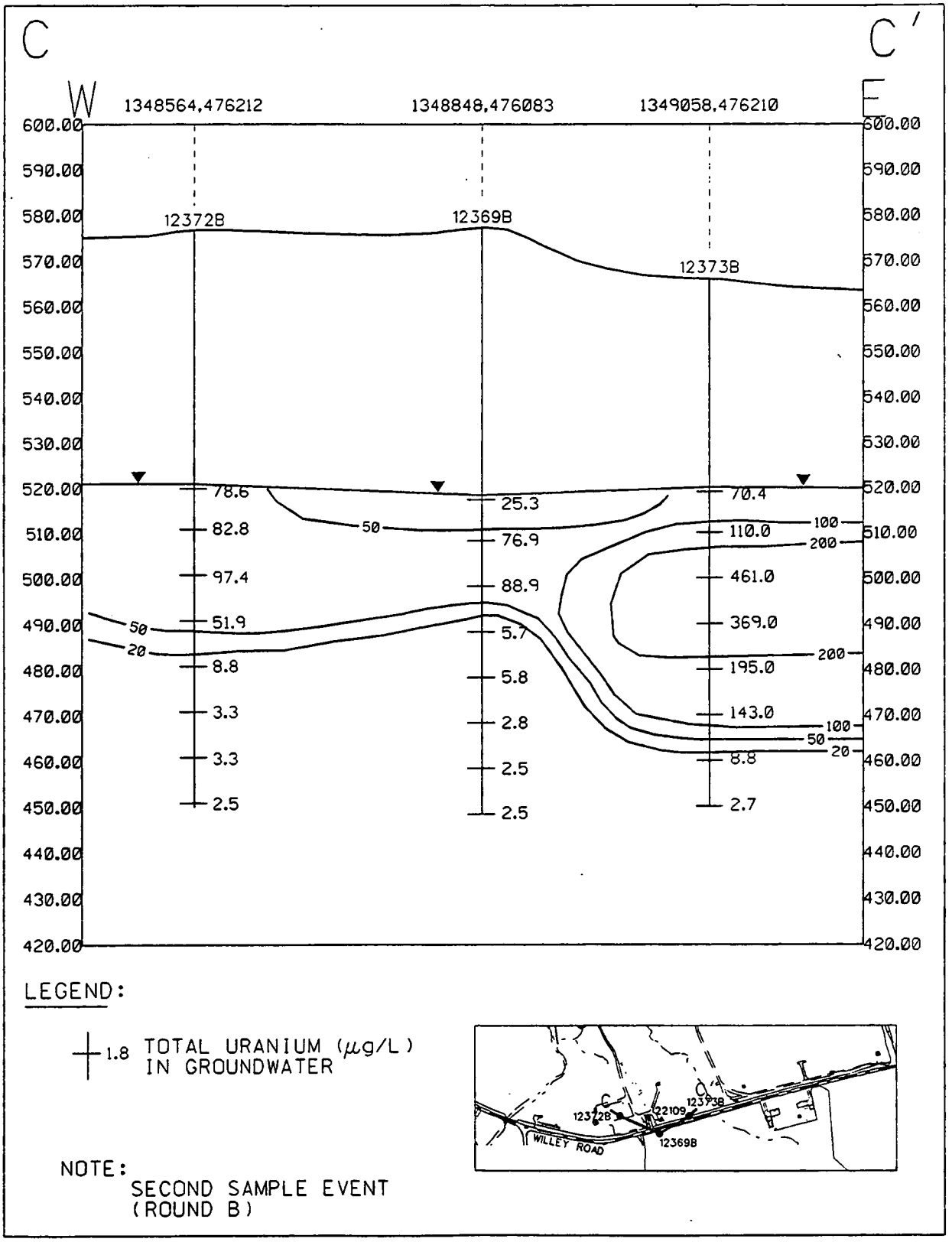
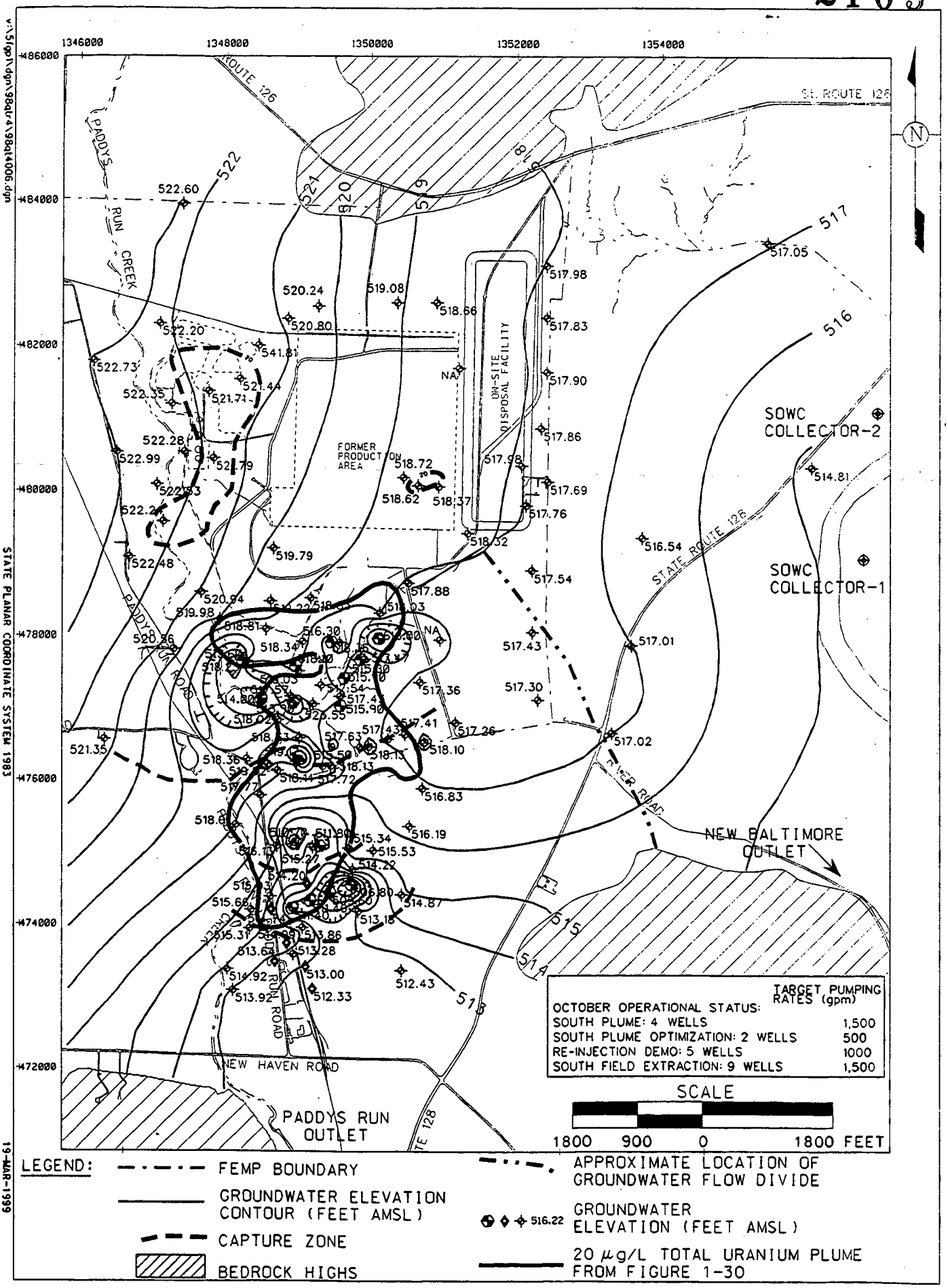


FIGURE 1-31. CROSS SECTION C-C', GEOPROBE RESULTS FOR TOTAL URANIUM IN GROUNDWATER

000061



TARGET PUMPING RATES (gpm)	
OCTOBER OPERATIONAL STATUS:	
SOUTH PLUME: 4 WELLS	1,500
SOUTH PLUME OPTIMIZATION: 2 WELLS	500
RE-INJECTION DEMO: 5 WELLS	1000
SOUTH FIELD EXTRACTION: 9 WELLS	1,500

SCALE

1800 900 0 1800 FEET

LEGEND:

- FEMP BOUNDARY
- GROUNDWATER ELEVATION CONTOUR (FEET AMSL)
- CAPTURE ZONE
- BEDROCK HIGHS
- APPROXIMATE LOCATION OF GROUNDWATER FLOW DIVIDE
- 516.22 GROUNDWATER ELEVATION (FEET AMSL)
- 20 µg/L TOTAL URANIUM PLUME FROM FIGURE 1-30

v:\5lop1\dgn\98qtr4\98qt4006.dgn
STATE PLANAR COORDINATE SYSTEM 1983
19-MAR-1999

FIGURE 1-32. ROUTINE GROUNDWATER ELEVATIONS FOR TYPE 2 WELLS, OCTOBER 1998

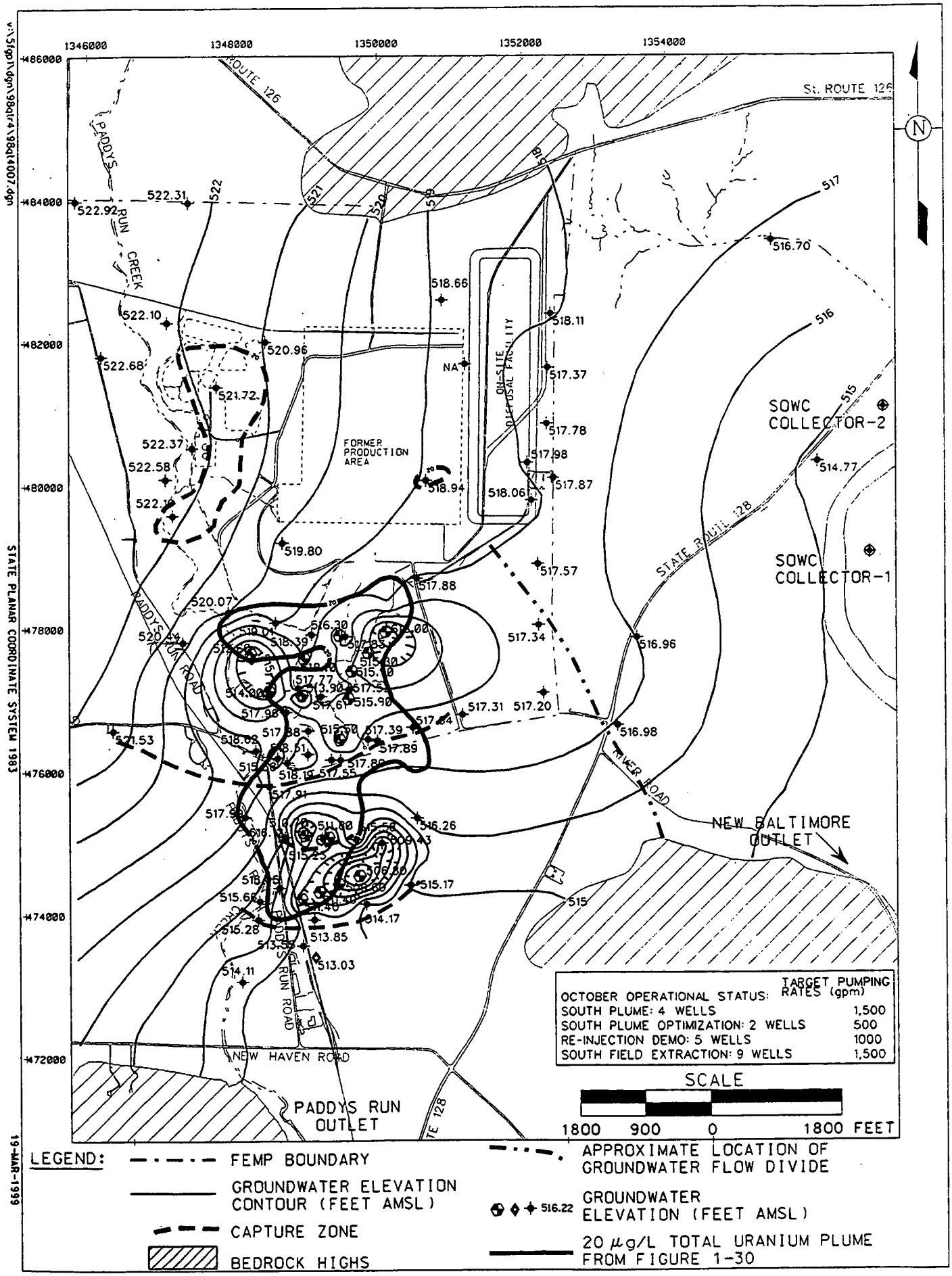


FIGURE 1-33. ROUTINE GROUNDWATER ELEVATIONS FOR TYPE 3 WELLS, OCTOBER 1998

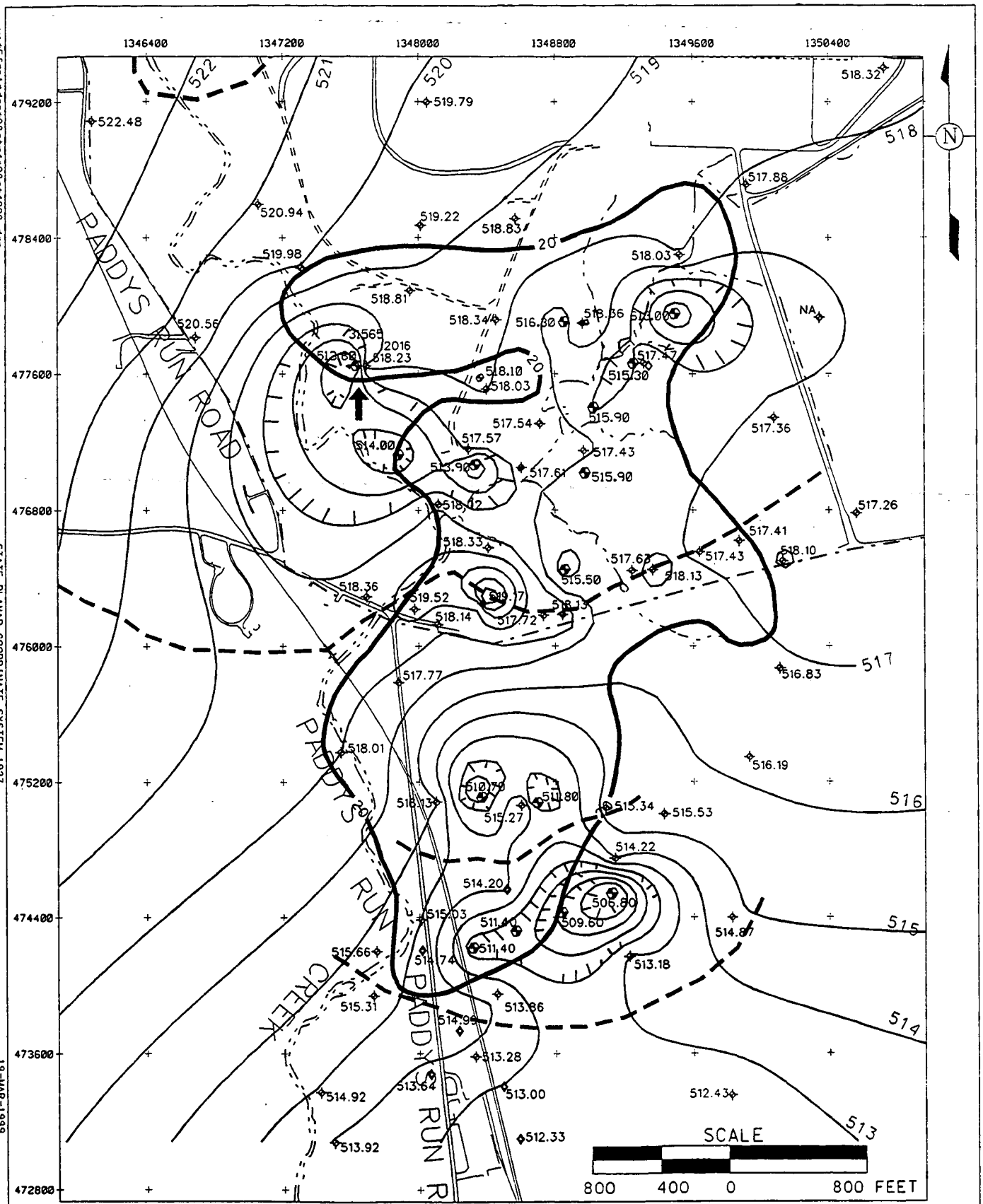
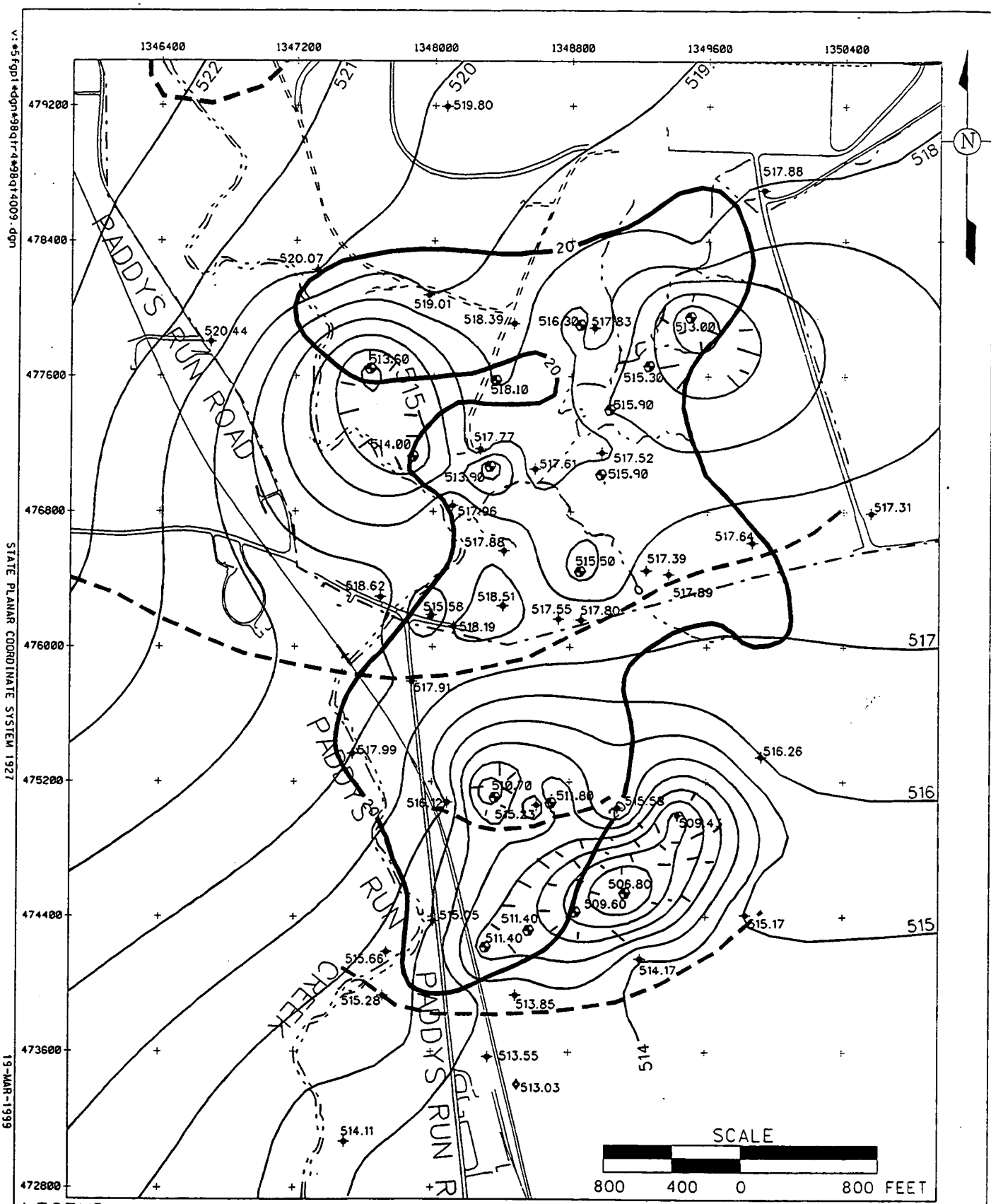


FIGURE 1-34. DETAILED GROUNDWATER ELEVATIONS FOR TYPE 2 WELLS, OCTOBER 1998



LEGEND:

- FEMP BOUNDARY
- GROUNDWATER ELEVATION CONTOUR (FEET AMSL)
- CAPTURE ZONE
- 517.76 GROUNDWATER ELEVATION (FEET AMSL)
- 20 μg/L TOTAL URANIUM PLUME FROM FIGURE 1-30

FIGURE 1-35. DETAILED GROUNDWATER ELEVATIONS FOR TYPE 3 WELLS, OCTOBER 1998

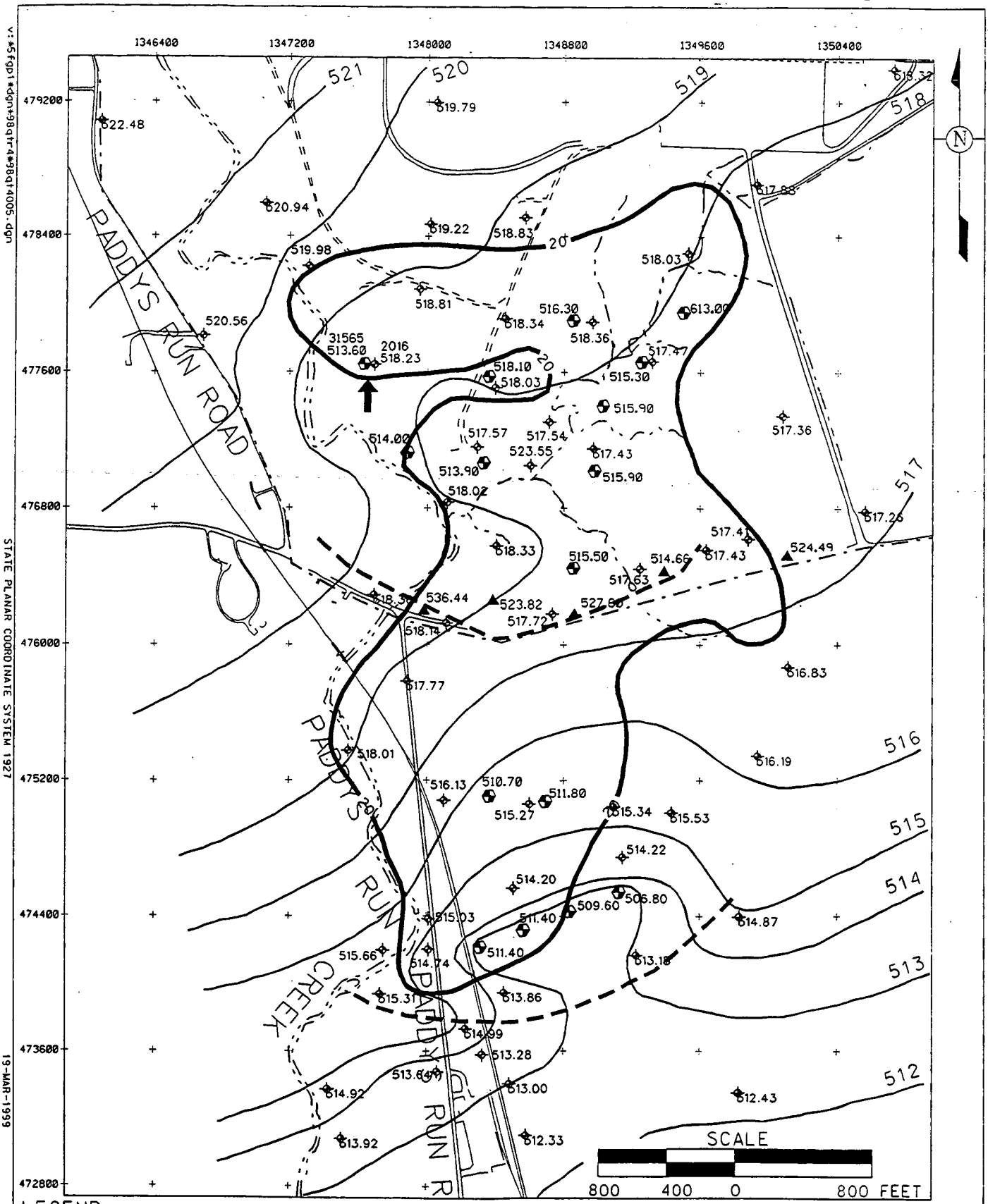


FIGURE 1-36. DETAILED GROUNDWATER ELEVATIONS FOR TYPE 2 MONITORING WELLS, OCTOBER 1998

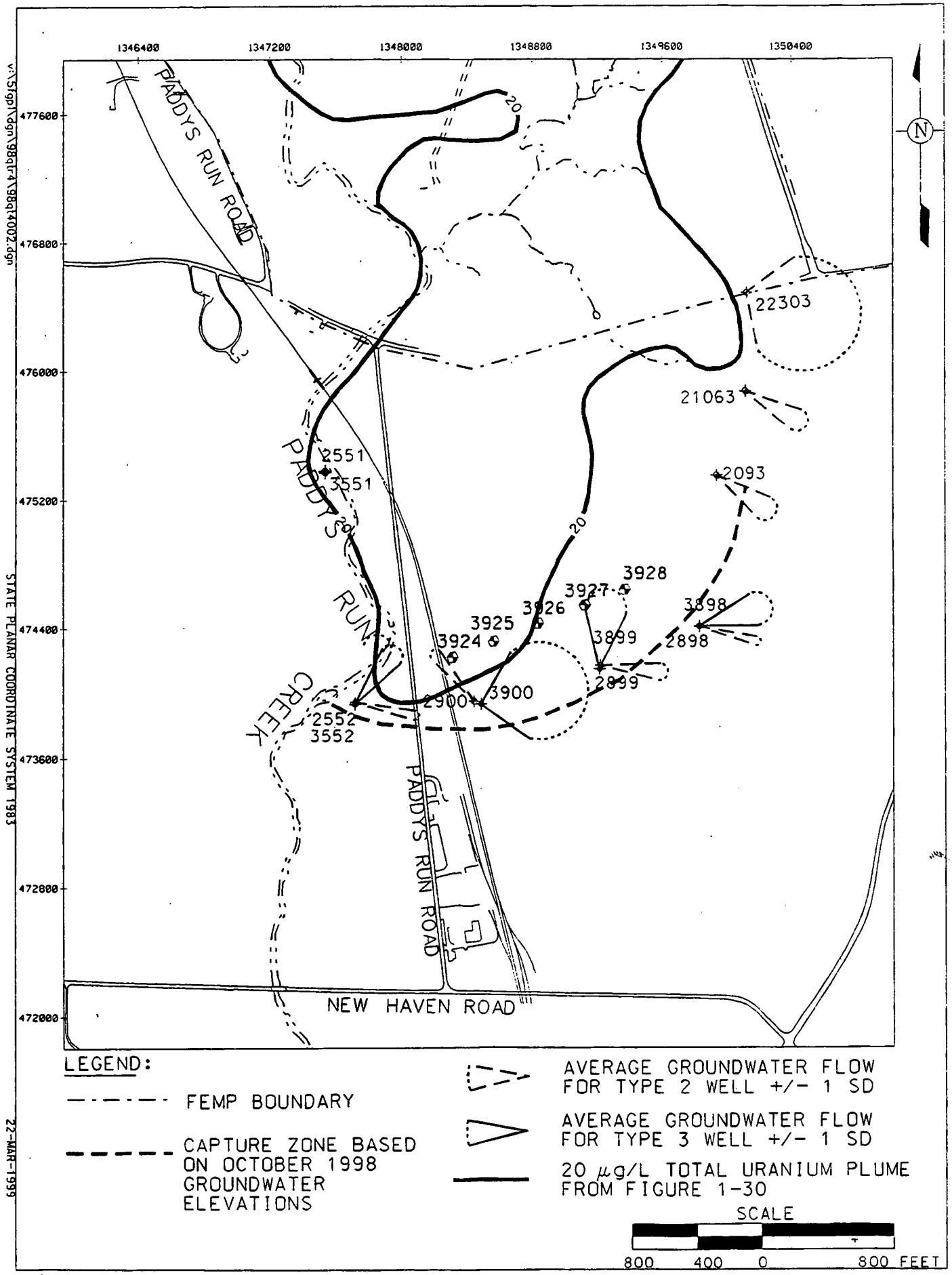
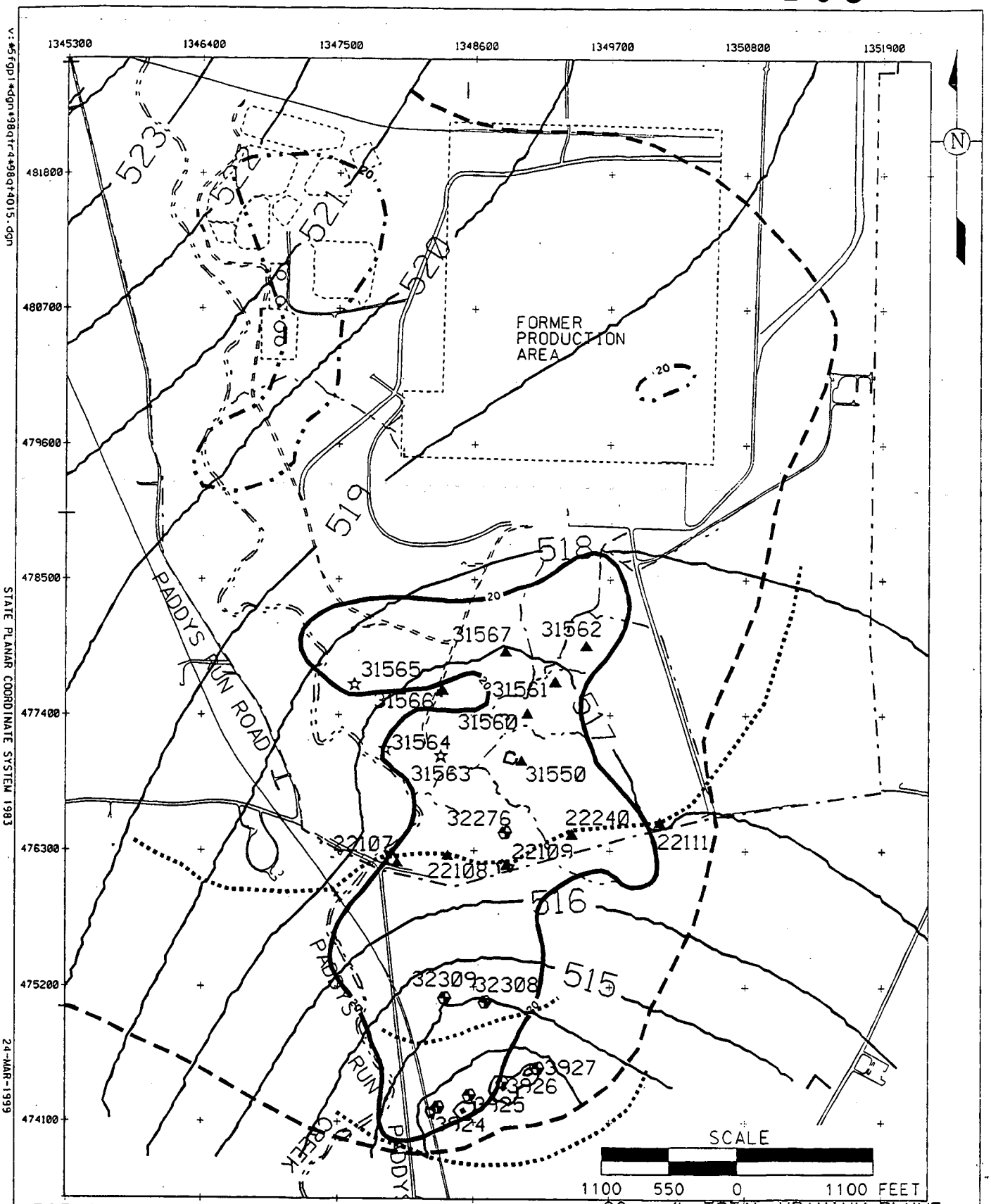


FIGURE 1-37. COLLOIDAL BORESCOPE FLOW VECTORS AT SOUTHERN EXTENT OF CAPTURE ZONE, FOURTH QUARTER 1998



LEGEND:

- FEMP BOUNDARY
- INTERPRETED CAPTURE ZONES, OCTOBER 1998
- 10-YEAR, URANIUM-BASED RESTORATION FOOTPRINT
- 20 µg/L TOTAL URANIUM PLUME FROM FIGURE 1-30
- RE-INJECTION WELL
- EXTRACTION WELL
- EXTRACTION/RE-INJECTION WELL
- PLUME SEGMENT FROM SECOND QUARTER STATUS REPORT

FIGURE 1-38. MODELED GROUNDWATER ELEVATIONS FOR OCTOBER 1998 OPERATIONAL CONDITIONS

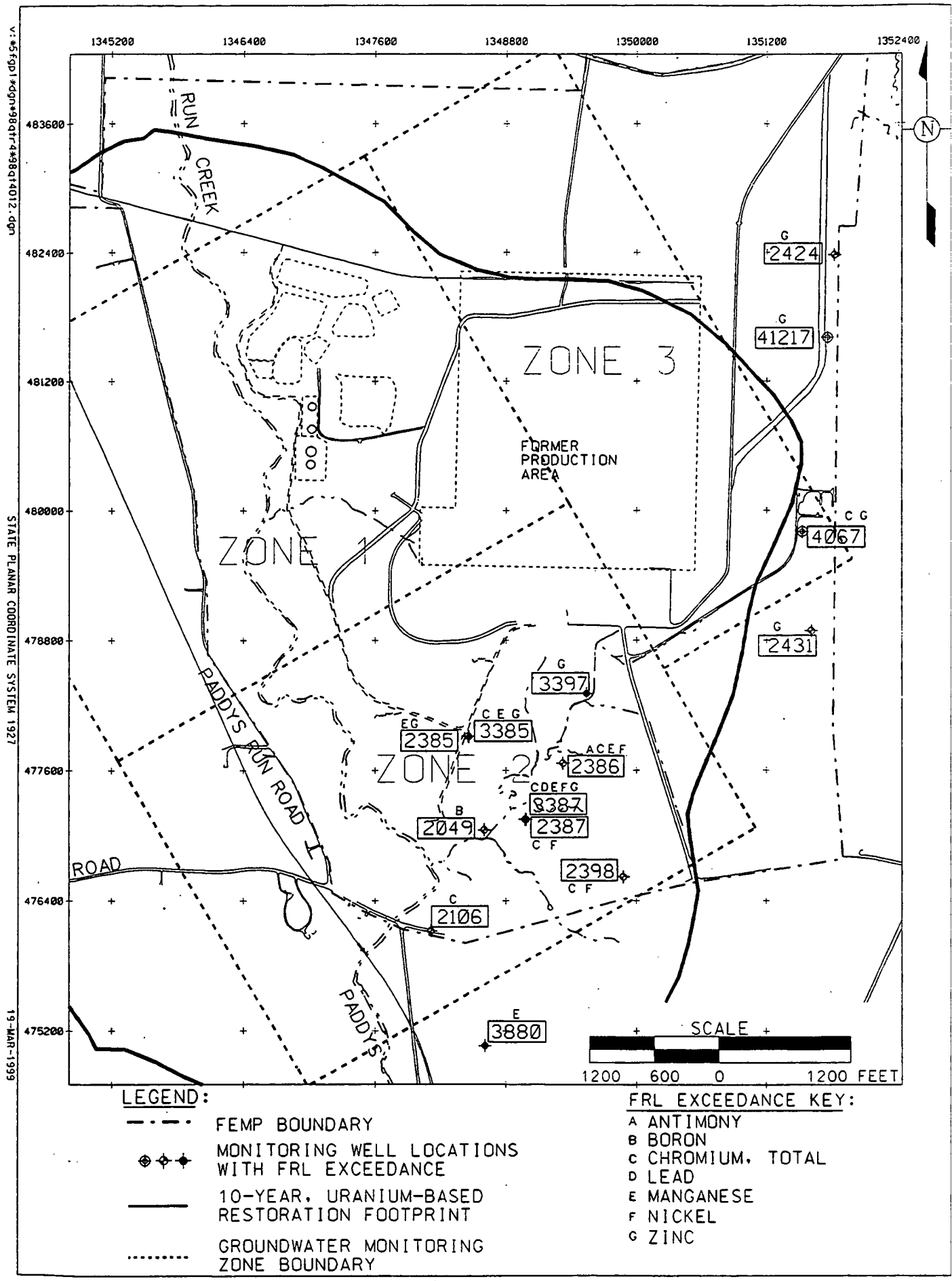


FIGURE 1-39. NON-URANIUM CONSTITUENTS WITH THIRD QUARTER 1998 RESULTS ABOVE FINAL REMEDIATION LEVELS

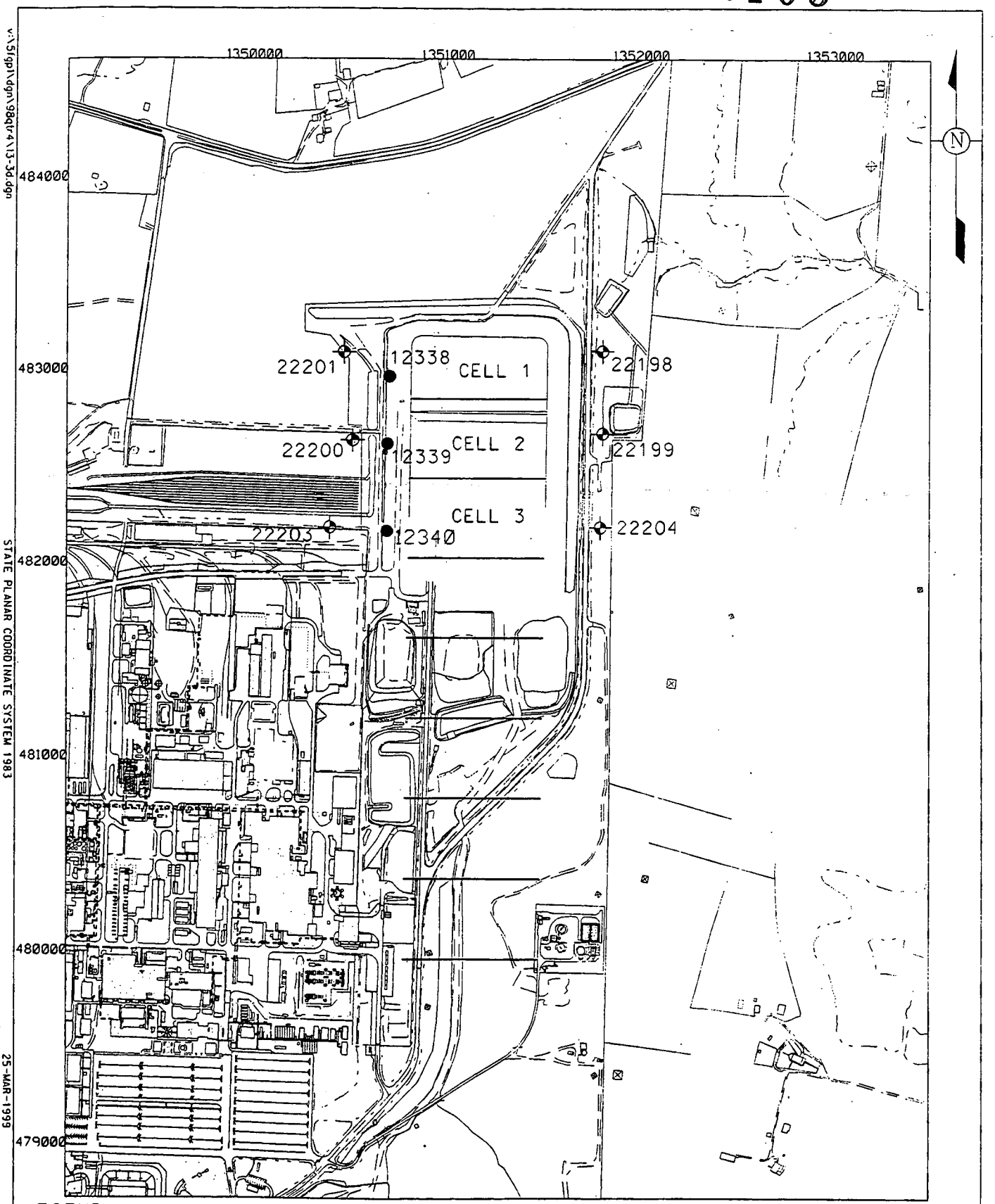


FIGURE 1-40. ON-SITE DISPOSAL FACILITY WELL LOCATIONS

FIGURE 1-41

GROUNDWATER SAMPLING ACTIVITIES COVERED IN THE NEXT QUARTERLY REPORT

SAMPLING ACTIVITIES	1999											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
South Plume/South Plume Optimization Modules: Operational Aquifer Conditions[a]	♦	♦	♦									
South Field Extraction Module: Operational (Phase 1) Aquifer Conditions[a]	♦	♦	♦									
Re-Injection Demonstration Module[b]: Operational	♦	♦	♦									
Waste Storage Area Module: Aquifer Conditions[a]												
Plant 6 Area Module: Aquifer Conditions[a]												
Routine Water-Level/Flow Direction Monitoring	♦											
RCRA Property Boundary Monitoring[a]												
Private Well Monitoring[a]												
KC-2 Warehouse Monitoring[a]												
OSDF Groundwater Monitoring[a]: Post-Baseline (Cell 1)												
Baseline (Cell 2)												
Baseline (Cell 3)												

♦ Data summarized/evaluated in the next report

[a]Fourth quarter 1998 data will be included in the 1998 Integrated Site Environmental Report.
[b]Aquifer conditions for this module are monitored under the South Plume Module, South Field Module, and the RCRA Property Boundary Program.

2.0 SURFACE WATER AND TREATED EFFLUENT UPDATE

2.1 INTRODUCTION

This section provides a status of the surface water and treated effluent monitoring for the fourth quarter of 1998. Figure 2-1 shows the data included in this section. Figure 2-2 identifies the surface water and treated effluent sample locations. Analytical results from the following routine monitoring program elements were utilized to complete the reporting requirements as identified in Section 4.6.2 of the IEMP:

- National Pollutant Discharge Elimination System (NPDES) permit (data obtained from October through December 1998)
- Federal Facilities Compliance Agreement (FFCA) requirements (data obtained from October through December 1998)
- IEMP Characterization Program results (data obtained from July through September 1998).

2.2 FINDINGS

The principal findings from the reporting period are summarized below:

NPDES Permit Compliance

- Wastewater and storm water discharges from the FEMP were in compliance 98.6 percent of the time during the fourth quarter of 1998. The NPDES noncompliances during the fourth quarter of 1998 included:
  - The daily maximum total suspended solid concentration limit for the sewage treatment plant effluent (STP 4601 - an internal monitoring point) was exceeded on November 16, 1998, due to the continuing problems associated with the suspended solids control. The monthly average total suspended solid concentration was also exceeded at the sewage treatment plant. These permit exceedances at the sewage treatment plant did not cause an exceedance at the Parshall Flume (PF 4001) which is the final effluent sample location prior to discharge into the Great Miami River.
  - In December the daily total suspended solids mass loading limit was exceeded twice at the Parshall Flume due to pumping of storm water directly from the Storm Water Retention Basin to the Great Miami River. The pumping was successful in preventing an overflow at the Storm Water Retention Basin in December. In addition the effluent at the sewage treatment plant exceeded the daily maximum total suspended solids concentration limit three times and also

exceeded the monthly average concentration limit for total suspended solids. As identified in the December 1998 Noncompliance Report (letter [FDF-99-0003], dated January 14, 1999, from Fluor Daniel Fernald to OEPA), past corrective actions have been unsuccessful and it is believed that the noncompliances are related to low organic loading in the aeration basin. Details on the corrective actions that have been and will be conducted are identified within the December 1998 Noncompliance Report. (Refer to Table 2-1 for more information on the storm water overflow and treatment bypass events.)

- The following remediation activities continued to occur during the fourth quarter of 1998 which could have potentially impacted the water quality at various surface water sample locations (identified in parentheses):

  - Excavation, screening, and hauling activities in the on-site disposal facility borrow area (SWD-02 and STRM 4003)

  - Placement of waste material into on-site disposal facility Cell 1 (PF 4001)

  - Construction activities associated with on-site disposal facility Cells 2 and 3 (SWD-02 and STRM 4003)

  - Excavation activities associated with Area 2 Phase I, the southern waste units remediation activities (STRM 4003, STRM 4004, and PF 4001)

  - Limited activities in the north railyard, such as installation of lighting (STRM 4006)

  - Construction activities associated with the Waste Pit Remedial Action Project (PF 4001 and STRM 4006)

  - Excavation activities associated with Area 1, Phase II site preparation activities (SWD-02 and STRM 4003).

  Review of the surface water and treated effluent data provided with this report does not indicate that these activities have caused any persistent FRL or benchmark toxicity value (BTV) exceedances (identified in surveillance subsection). However, data will continue to be evaluated in light of ongoing remediation activities to assess impacts to the surface water pathway.

FFCA and Operable Unit 5 Record of Decision Compliance

- Figure 2-3 shows that a cumulative total of 216 pounds of uranium were discharged to the Great Miami River in effluent from January through December 1998. The Record of Decision for Remedial Actions at Operable Unit 5 established an annual discharge limit to the Great Miami River of 600 pounds for total uranium.

- Uncontrolled runoff is also contributing to the amount of total uranium entering the environment. An estimated 6.25 pounds of total uranium are discharged to Paddys Run through uncontrolled runoff with every inch of rain. Note that the 6.25 value was

determined prior to the initiation of remediation activities and may result in conservative uncontrolled runoff mass estimates. Figure 2-4 shows that precipitation during the fourth quarter of 1998 amounted to 8.76 inches; therefore, the mass of total uranium discharged to Paddys Run through uncontrolled runoff from October through December 1998 is estimated to be 54.75 pounds.

- Figure 2-5 illustrates that the monthly average total uranium concentration limit of 20 µg/L for water discharged to the Great Miami River was not met during one month of the fourth quarter, specifically December. The average concentration for December was 23.6 µg/L after eliminating from the monthly average those concentrations observed during the two bypass days associated with treatment plant maintenance. As identified in the Operable Unit 5 Record of Decision, discharge concentrations which occur during treatment plant maintenance bypass days may be eliminated from the monthly average concentration. Additionally, 10 significant precipitation bypass days per year are allowed to be eliminated from the monthly average concentration per the Operable Unit 5 Record of Decision. During December there was also a significant precipitation bypass day. However, the 10 allowable significant precipitation days had occurred in previous quarters. Therefore, the discharge concentration from the one significant precipitation bypass day experienced in December 1998 was included in the monthly average total uranium calculation. Further discussions of the events leading to the December concentration limit exceedance are presented in a facsimile (letter [SWP(ARWWP):99-0003], dated February 1, 1999, from Fluor Daniel Fernald to EPA and OEPA) and in the following bullet. (Table 2-1 presents the details concerning these bypasses.)

- On October 13, 1998 (fourth quarter of 1998), a meeting with EPA and OEPA was held to discuss ways to mitigate bypassing and overflowing of the Storm Water Retention Basin. Corrective actions discussed at this meeting consisted of operational changes that are summarized in a facsimile (letter [SWP(ARWWP):99-0001], dated January 11, 1999, from Fluor Daniel Fernald to EPA and OEPA) and include:

  - Operating the Storm Water Retention Basin as a detention basin rather than a retention basin, thereby allowing flow to be pumped from the basin while it fills as opposed to waiting until after a storm event ends

  - Maximizing the Storm Water Retention Basin capacity by operating the basins at the lowest possible level

  - Raising the level at which storm water bypassing to the river begins and ends by one foot

  - Stop pumping the storm water from the Southern Waste Unit Basins to the Storm Water Retention Basin when the water levels are such that the east and west chambers of the Storm Water Retention Basin become common. Pumping from the Southern Waste Unit Basins is not to resume until the water levels in the basins are such that the chambers of the Storm Water Retention Basin can be differentiated.

Some of these operational changes were initiated during the fourth quarter of 1998. The significant precipitation bypass on December 21 through 23, 1998, was due in part

to not having fully implemented all of the changes identified above. Specifically, storm water from the Southern Waste Unit Basins continued to be sent to the Storm Water Retention Basin after the above noted "stop pumping" level had been reached. The bypass probably could not have been completely avoided because of the heavy rainfall. Nonetheless, it is likely that the duration of the bypass event would have been shortened if the flow of storm water from the Southern Waste Unit Basins had been curtailed prior to bypassing. It is important to note that after this bypass occurred, the operational modification identified above pertaining to the southern waste units was implemented. In addition, it was identified to EPA and OEPA during a conference call on December 22, 1998, that a number of groundwater extraction wells were shut down and the aquifer re-injection water (treated groundwater) was re-routed in an effort to mitigate the high total uranium concentrations from the Storm Water Retention Basin bypass event.

Additional discussions continue with EPA and OEPA to status the effectiveness and implementation of the operational changes. Corrective actions that have resulted from these discussions will continue to be reported through IEMP quarterly status reports and will also be documented in the revised Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project to be issued in the spring of 1999.

Figure 2-6 presents controlled and uncontrolled surface water flow areas for the fourth quarter of 1998. As identified in previous IEMP quarterly status reports, an evaluation of controlled areas is to occur at least quarterly in order to help ensure that the appropriate areas are being controlled.

Surveillance Monitoring

- There were no FRL exceedances attributable to the FEMP during this reporting period.
- There were no BTV exceedances attributable to the FEMP observed in the Great Miami River. However, one BTV for silver was exceeded at STRM 4004. This is the first time that silver has been exceeded at this location. Data will continue to be evaluated to ascertain the significance of this exceedance both at this location and downstream. (Refer to Table 2-2 for BTV exceedances.)
- There were no exceedances of the 530 µg/L surface water total uranium FRL. As Figure 2-7 shows, results from the property boundary at Paddys Run (SWP-03) indicate that total uranium concentrations in surface water leaving the site are consistently below both the surface water FRL and the groundwater FRL.
- There were several locations that were dry during the third quarter of 1998. The locations were as follows: August (SWP-02, SWP-03, and SWD-01) and September (SWP-02 and SWP-03). The quarterly list of constituents, as identified in the IEMP, Revision 0, are sampled during the last month of each quarter; whereas, the monthly list of constituents are sampled during the other months of each quarter. There were also several locations that were dry during the fourth quarter. They were as follows: October (SWP-02, SWP-03, SWD-01, and SWD-02) and November (SWP-03).

The next IEMP quarterly status report, to be issued June 28, 1999, will include NPDES and FFCA data from January through March 1999 (first quarter). However, the remaining analytical data from the IEMP Characterization Program from October through December 1998 (fourth quarter) will be presented in the 1998 Integrated Site Environmental Report to be submitted June 1, 1999. Figure 2-8 shows the data from the surface water and treated effluent sampling activities that will be included in the next IEMP quarterly status report.

TABLE 2-1

1998 STORM WATER RETENTION BASIN OVERFLOWS AND TREATMENT BYPASS EVENTS

Event	Duration (hours)	Number of Bypass Days[a,b]	Cumulative Number of Bypass Days[b]	Total Uranium Discharged (pounds)	Total Water Discharged (millions of gallons)
Overflows				(to Paddys Run)	(to Paddys Run)
April 16	15.9	NA	NA	1.99	1.39
July 20	8.25	NA	NA	0.48	0.55
Significant Precipitation Bypasses				(to Great Miami River)	(to Great Miami River)
January 7 through January 9	53.8	2	2	7.82	3.19
April 16 through April 19	76.8	3	5	9.78	6.09
June 11 through June 14	80.0	3	8	11.16	5.72
June 16 through June 17	22.8	0	8	2.48	1.43
June 19 through June 20	24.0	1	9	3.17	2.01
July 20 through July 23	83.8	4[c]	13	6.45	6.17
December 21 through December 23	34.7	1[d]	14	4.92	2.04
Treatment Plant Maintenance Bypasses					
December 18 through December 19	48.0	2	2	3.81	9.75

[a]Days are counted according to the definition provided in the Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project (DOE 1997e).
[b]NA = not applicable
[c]The duration of the storm water bypass for this event was exacerbated because storm water runoff from the construction of on-site disposal facility Cells 2 and 3 was mistakenly pumped to the site's storm sewer system and subsequently delivered to the Storm Water Retention Basin during this period. These waters did not require treatment because no impacted material had been placed in Cells 2 and 3. A corrective action was initiated in the third quarter of 1998 to stop any further storm water runoff from on-site disposal facility Cells 2 and 3 prior to waste placement.
[d]The significant precipitation bypass on December 21 through December 23, 1998, was due in part to storm water from the southern waste units which continued to be sent to the Storm Water Retention Basin after the bypass event had been initiated.

TABLE 2-2

SURFACE WATER LOCATIONS WITH RESULTS ABOVE THE BTV, INCLUDING SUMMARY STATISTICS

Sample Location[a]	Constituent	Total Number of Samples Since January 1, 1997[b,c,d]	Number of Samples with BTV Exceedances Since January 1, 1997[b,c,d]	Number of Samples with BTV Exceedances for Third/Fourth Quarters 1998[b,c,d]	BTV[e] (mg/L)	Summary Statistics[c,f,g]			Results with BTV Exceedances for Third/Fourth Quarters 1998		
						Min. (mg/L)	Max. (mg/L)	Avg. (mg/L)	Sample Result (mg/L)	Validation Qualifier[h]	Sample Date
STRM 4004 (Storm Sewer Outfall Ditch)	Silver	4	1	1	0.0013	0.00045	0.005[i]	0.0025	0.0034	NV	12/22/98

[a]See Figure 2-2
[b]Total number of samples is from all programs including NPDES, NPDES permit renewal, FFCA, and IEMP Characterization Program.
[c]If more than one sample is collected per surface water location per day (e.g., duplicate, grab, composite), then only one sample is counted for the total number of samples and the sample with the maximum concentration is used for the summary statistics and in determining BTV exceedances.
[d]Rejected data qualified with either a R or Z were not used for this table.
[e]From IEMP, Table 3-2
[f]If the total number of samples is greater than or equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then none of the summary statistics are reported.
[g]For results where the concentrations are below the detection limit, the results used in the summary statistics are each set at half the detection limit.
[h]Validation qualifier codes are provided in Appendix D of the Sitewide CERCLA Quality Assurance Project Plan.
[i]This value is actually a non-detectable result from prior to IEMP implementation and, due to the elevated detection limit, is not considered an FRL exceedance.

FIGURE 2-1

SURFACE WATER AND TREATED EFFLUENT SAMPLING ACTIVITIES COVERED IN THIS QUARTERLY REPORT

SAMPLING ACTIVITIES	1998											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NPDES										♦	♦	♦
FFCA										♦	♦	♦
IEMP Characterization							♦	♦	♦			

♦ Data summarized/ evaluated in this report

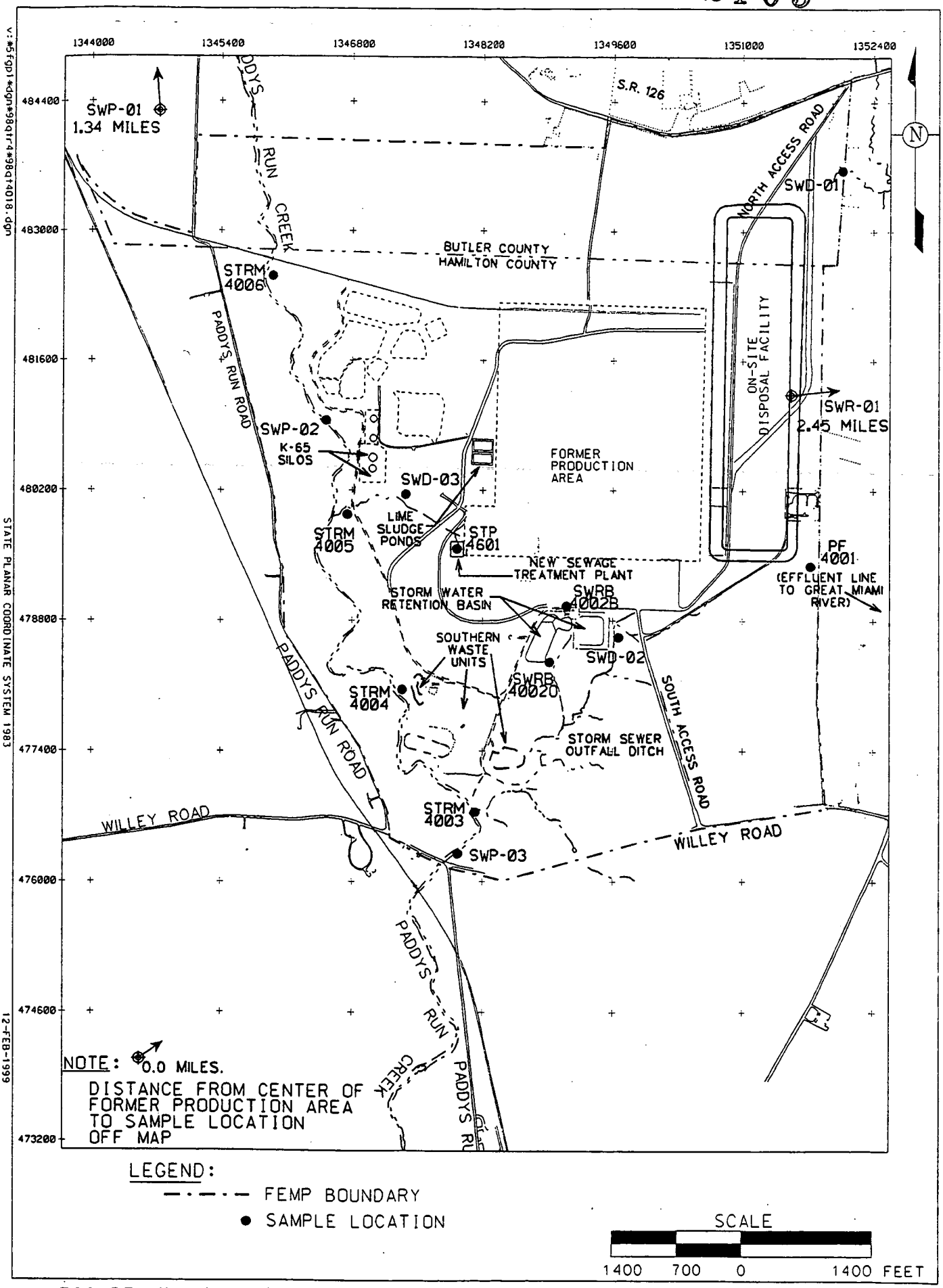
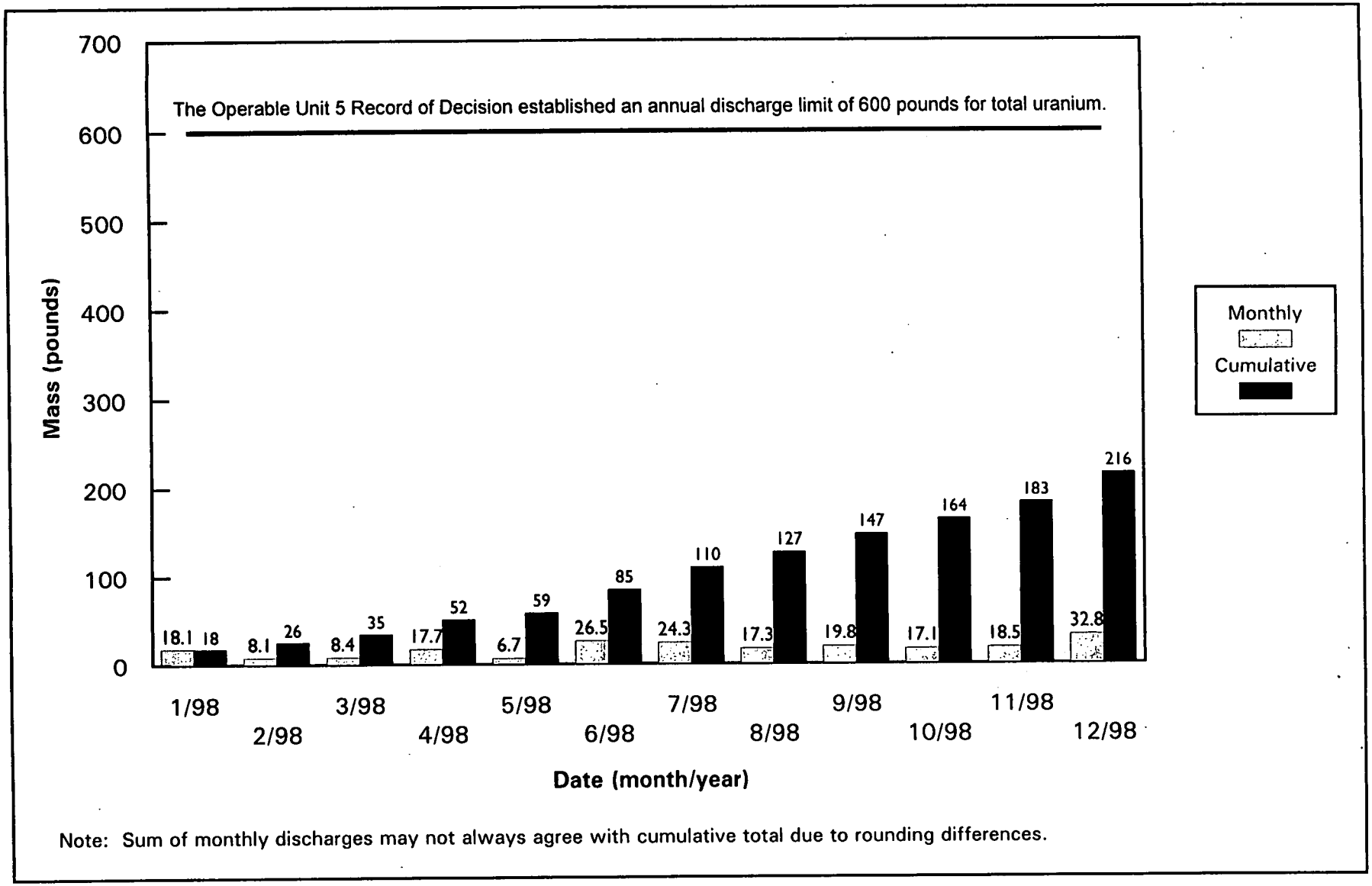
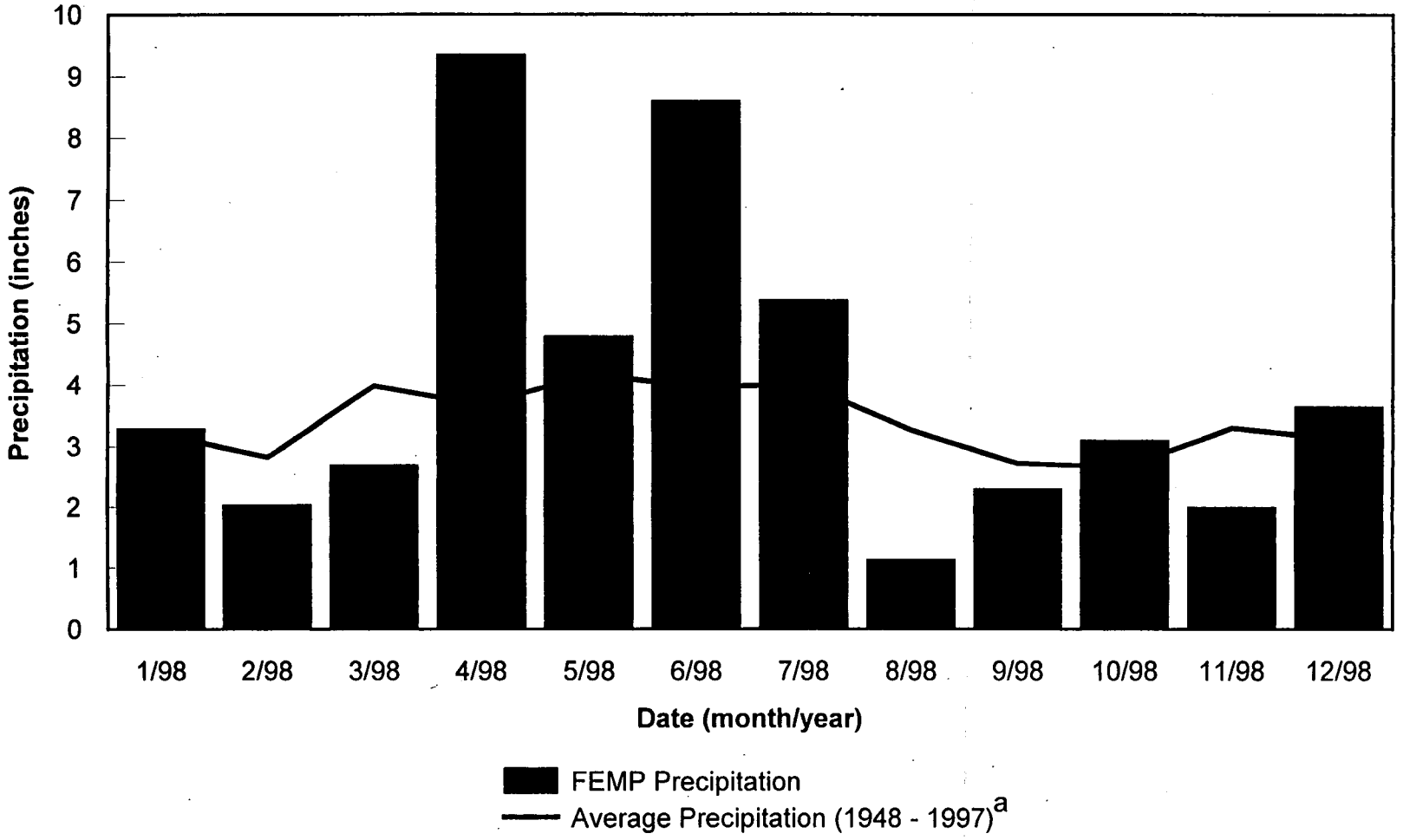


FIGURE 2-2.11 SURFACE WATER AND TREATED EFFLUENT SAMPLE LOCATIONS



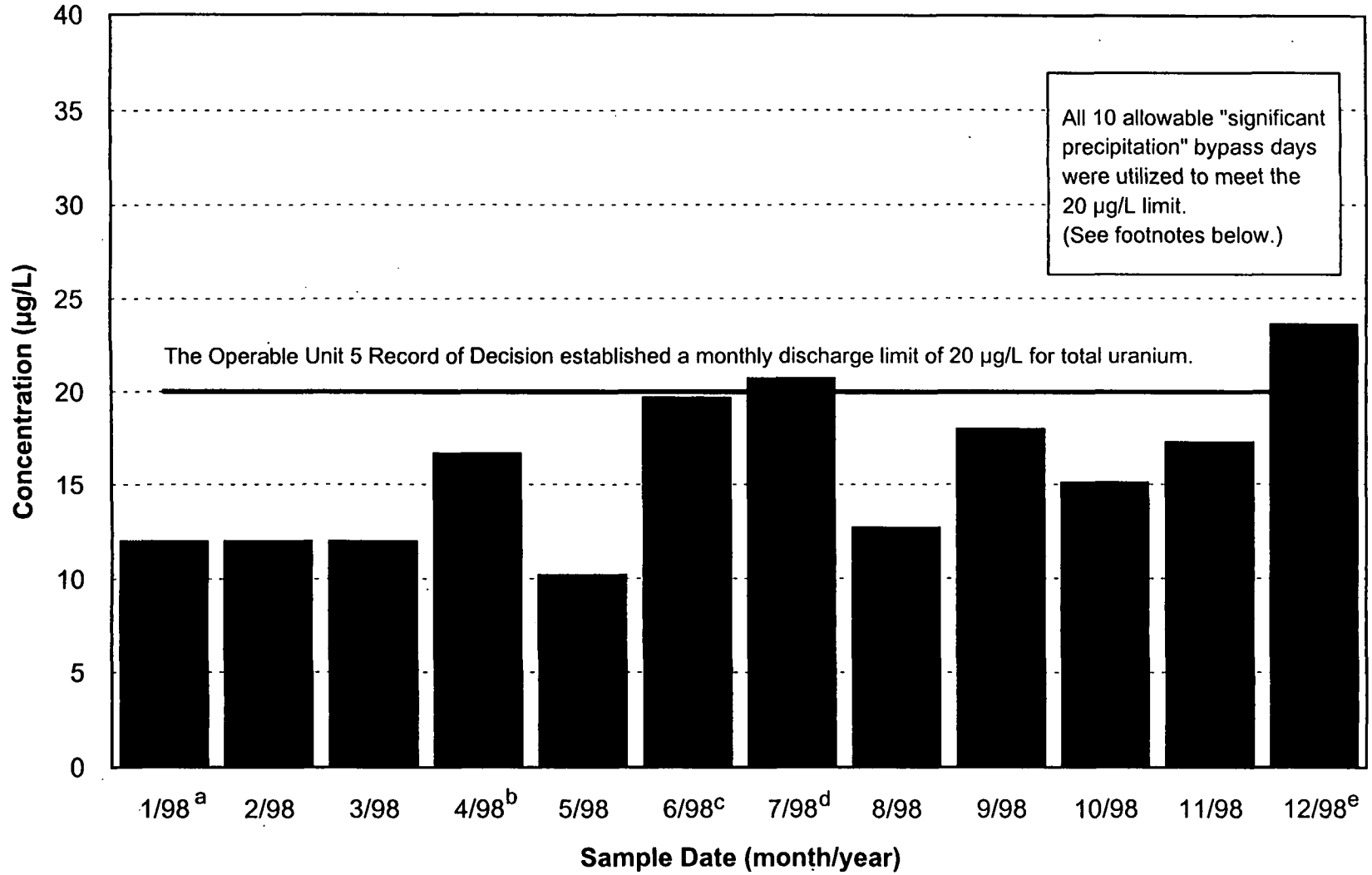
Note: Sum of monthly discharges may not always agree with cumulative total due to rounding differences.

FIGURE 2-3. POUNDS OF URANIUM DISCHARGED TO THE GREAT MIAMI RIVER FROM THE PARSHALL FLUME (PF 4001) IN 1998



[a] Average precipitation is based on data collected at the Greater Cincinnati/Northern Kentucky International Airport.

FIGURE 2-4. 1998 FEMP MONTHLY PRECIPITATION DATA



a) Actual concentration was 23.2 µg/L. Eliminating the two "significant precipitation" bypass days reduces average to 12.0 µg/L.
b) Actual concentration was 33.3 µg/L. Eliminating the three "significant precipitation" bypass days reduces average to 16.7 µg/L.
c) Actual concentration was 33.2 µg/L. Eliminating the four "significant precipitation" bypass days reduces average to 19.7 µg/L.
d) Actual concentration was 21.5 µg/L. Eliminating the one "significant precipitation" bypass day reduces average to 20.7 µg/L.
e) Actual concentration was 25.0 µg/L. Eliminating two "treatment plant maintenance" bypass days reduces average to 23.6 µg/L.

FIGURE 2-5. 1998 MONTHLY AVERAGE TOTAL URANIUM CONCENTRATION IN WATER DISCHARGED FROM THE PARSHALL FLUME (PF 4001) TO THE GREAT MIAMI RIVER

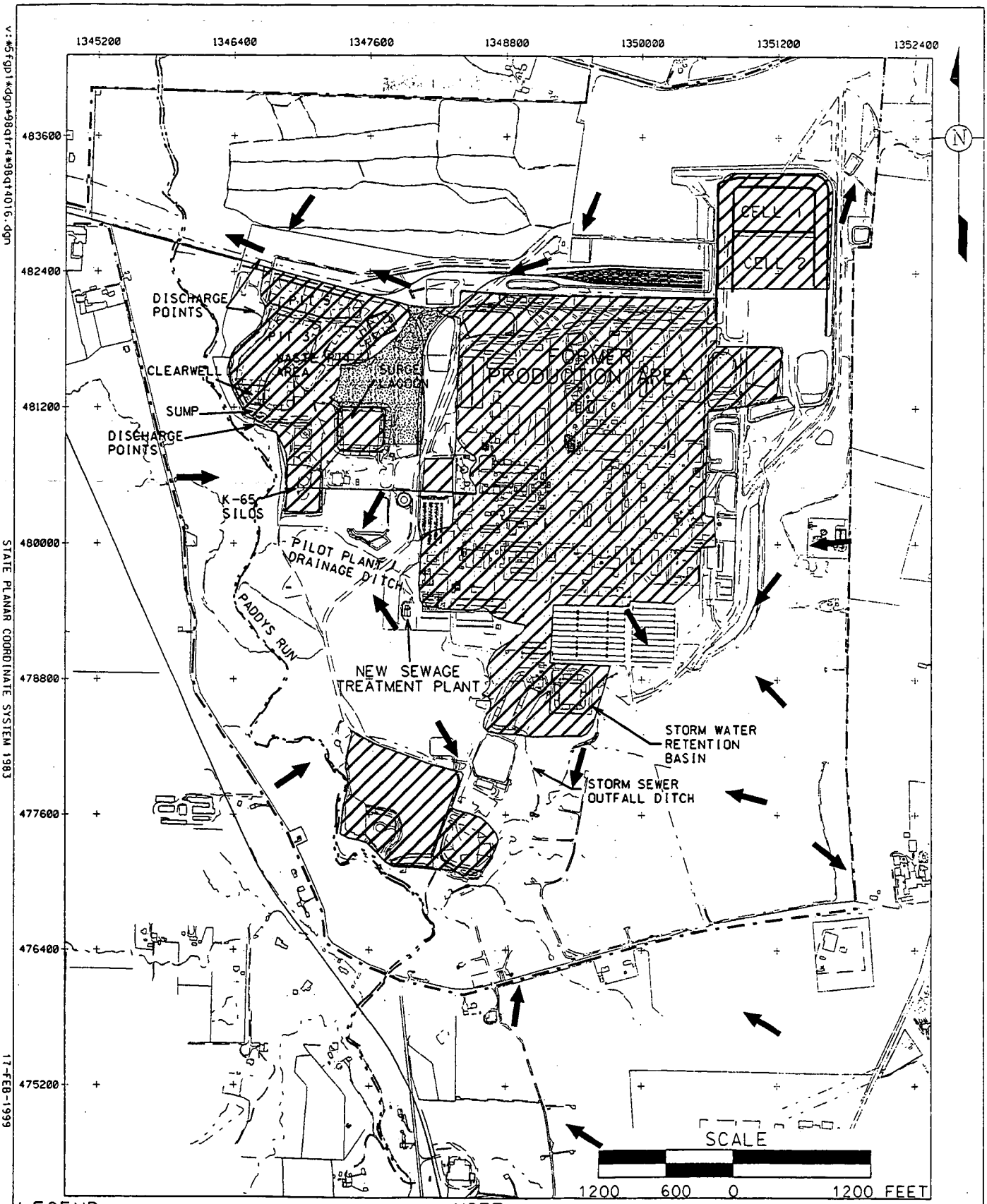


FIGURE 2-6. CONTROLLED SURFACE WATER AREAS AND UNCONTROLLED FLOW DIRECTIONS FOR FOURTH QUARTER 1998

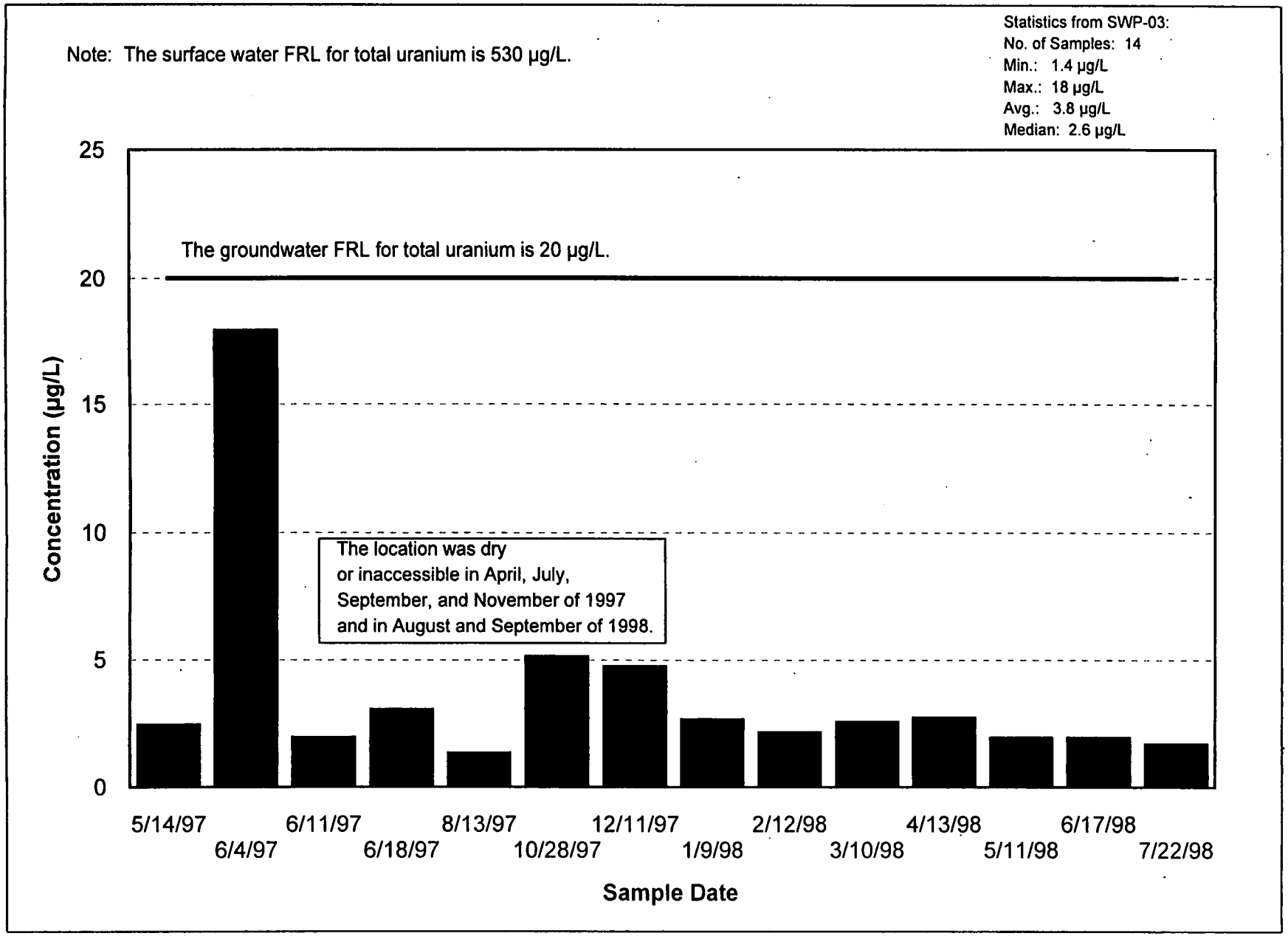


FIGURE 2-7. TOTAL URANIUM CONCENTRATIONS IN PADDYS RUN AT WILLEY ROAD (SWP-03) SAMPLE LOCATION

FIGURE 2-8

SURFACE WATER AND TREATED EFFLUENT SAMPLING ACTIVITIES COVERED IN THE NEXT QUARTERLY REPORT

SAMPLING ACTIVITIES	1999											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NPDES	♦	♦	♦									
FFCA	♦	♦	♦									
IEMP Characterization[a]												

♦ Data summarized/ evaluated in the next report

[a]Fourth quarter 1998 data will be included in the 1998 Integrated Site Environmental Report.

3.0 AIR MONITORING UPDATE

3.1 INTRODUCTION

This section provides a summary of the fourth quarter 1998 monitoring activities and analytical results for the IEMP air monitoring program. Figure 3-1 shows the data included in this section. Analytical results from the following routine air monitoring program elements and project-specific air monitoring activities covered in this section include:

- Radiological Air Particulate Monitoring:
  - National Emissions Standards for Hazardous Air Pollutant (NESHAP) Compliance
  - Project-Specific Air Monitoring at the Thorium/Plant 9 Complex and Sewage Treatment Plant Complex
  - Air Particulate Monitoring Research Project
- Radon Monitoring:
  - Continuous Alpha Scintillation Monitoring - Silo Head Space and Environmental Data
- Direct Radiation Monitoring (via thermoluminescent dosimeters [TLDs])
- NESHAP Stack Emissions Monitoring.

3.2 FINDINGS

The principal findings from this reporting period are summarized below:

Radiological Air Particulate Monitoring

- As part of the air monitoring program changes implemented in the IEMP, Revision 1 (DOE 1998b), two additional fenceline air monitoring locations were added to the IEMP radiological air particulate monitoring network late in the fourth quarter of 1998. The monitors, designated as WPTH-1 and WPTH-2 (refer to Figure 3-2), will be used to track fenceline thorium levels on a biweekly basis. These monitors were installed to address potential increases in airborne thorium concentrations, specifically thorium-230, resulting from fugitive emissions from the excavation of the waste pits which is scheduled to begin in mid-1999. Data from these monitors will be reported in future IEMP quarterly status and annual integrated site environmental reports.

  (Figure 3-2 identifies the location of the air monitoring stations and Figure 3-3 shows fourth quarter 1998 wind rose data.)

- Relative to the third quarter, a decrease in the quarterly average total uranium concentrations were observed at 15 of the 16 fenceline air particulate monitoring locations during the fourth quarter of 1998 (refer to Table 3-1). An average total uranium concentration increase of 21 percent occurred at AMS-22. The generally lower total uranium concentrations reflect the decrease in field activities as earth moving remediation projects were gradually suspended during the winter months. The increase at AMS-22 is not considered to be significant since the 1998 year-to-date maximum concentration at AMS-22 was not exceeded during the fourth quarter. While the overall fourth quarter averages were lower, short-term increases in total uranium concentrations were observed during November at AMS-3, AMS-8A, AMS-9C, and the project-specific air monitor STP-1. These monitors are along the east fenceline and generally downwind of the on-site disposal facility and the southeast sector of the site where soil excavations are occurring.

  Relative to 1998 year-to-date concentrations, average fourth quarter total uranium concentrations were lower at 13 of the 16 fenceline monitoring locations (refer to Table 3-1). The exceptions to the general decrease in total uranium concentrations were observed at AMS-4, AMS-22, and AMS-29. The increases at these monitors are not considered to be significant since the relevant 1998 year-to-date maximum concentrations were not exceeded during the fourth quarter. As noted earlier, the decrease in average total uranium concentrations is attributed to the suspension of remediation projects during the winter months.

- Average fourth quarter total particulate concentrations were lower at 14 of the 16 fenceline monitoring locations when compared to third quarter results (refer to Table 3-2). No changes were observed in the total particulate concentrations at AMS-4 and AMS-22, when compared to third quarter results.

  Relative to 1998 year-to-date concentrations, average fourth quarter total particulate concentrations were lower at 12 of the 16 fenceline monitoring locations (refer to Table 3-2). No changes were observed in the average fourth quarter total particulate concentrations at AMS-26 and AMS-28 when compared to 1998 year-to-date results. Increases in the average fourth quarter total particulate concentrations were observed at AMS-4 and AMS-22 when compared to 1998 year-to-date results. The increases at AMS-4 and AMS-22 are not considered to be significant because the quarterly average total particulate concentrations remained within the range of average total particulate concentrations measured at other fenceline and background monitors. Overall, the average fourth quarter and 1998 fenceline total particulate concentrations are comparable to the average background concentrations, suggesting efforts to control fugitive dust from remediation activities have been successful.

  (Refer to Tables 3-1 and 3-2 and Figures 3-4 through 3-10 for data summaries and graphs.)

NESHAP Compliance

- The maximum fourth quarter dose equivalent, calculated from the fourth quarter air composite data, was 0.052 millirem (mrem) which occurred at AMS-9C. Table 3-3 contains the fourth quarter doses for each fenceline monitoring location and the fractional contribution of each radionuclide to the total dose. Uranium contributed the majority of dose at the three fenceline monitors (AMS-3, AMS-8A, and AMS-9C) with the highest air inhalation dose equivalent for the fourth quarter. These three monitors are along the eastern fenceline of the site and generally downwind of the major remediation activities. For the fourth quarter, the results indicate that uranium contributed over 99 percent of the dose at AMS-3 and AMS-8A and 91 percent of the dose at AMS-9C.

  The maximum year-to-date dose equivalent, calculated from the sum of four quarterly air composites, was 0.25 mrem which occurred at AMS-3. This maximum fenceline dose represents 2.5 percent of the 10 mrem NESHAP Subpart H standard. Table 3-4 contains the year-to-date doses for each fenceline monitoring location and the fractional contribution of each radionuclide to the total dose. Four of the 16 fenceline monitors (AMS-3, AMS-8A, ASM-9C, and AMS-25) have year-to-date dose equivalents greater than one percent of the NESHAP standard. Three of the four (AMS-3, AMS-8A, and AMS-9C) are along the eastern fenceline of the site and generally downwind of the major remediation activities. The year-to-date results indicate that uranium contributed 88 percent of the dose at AMS-3, 94 percent of the dose at AMS-8A, and 81 percent of the dose at AMS-9C for the year. These uranium contributions to the dose equivalent are similar at other fenceline monitors and are consistent with historical data (uranium typically contributes greater than 62 percent of the dose at the FEMP). At AMS-25 thorium contributed 75 percent of the 0.11 mrem annual dose. As noted in the Integrated Environmental Monitoring Status Report for Second Quarter 1998 (DOE 1998c), evaluation of the analytical data associated with the second quarter AMS-25 composite sample indicated that the off-site laboratory experienced difficulties during the thorium analysis which may have contributed to unusually high thorium results. Specifically, the laboratory encountered reoccurring interferences during the thorium analysis resulting in low tracer recoveries. In adjusting the data for the low tracer recoveries, the thorium results may have been biased high, especially the thorium-230 results. While the thorium-230 data were not rejected through the validation process, they were qualified as "tentatively identified" indicating limited confidence in the results. The anomalously high second quarter thorium results are the reason thorium was the major contributor to annual dose at AMS-25.

  (Refer to Tables 3-3 and 3-4 and Figure 3-2 for data summaries and air monitoring locations.)

Project-Specific Air Monitoring

- Project-specific radiological air monitoring activities initiated during October 1997 continued through the fourth quarter of 1998 to support the decontamination and dismantlement of the Thorium/Plant 9 Complex. The monitoring program includes

five project-specific air monitoring stations located near the project boundary that are monitored weekly for total uranium and total particulate concentrations. This monitoring program is conducted under the Operable Unit 3, Integrated Remedial Action, Thorium/Plant 9 Complex Implementation Plan for Above-Grade Decontamination and Dismantlement (DOE 1997d).

Fourth quarter results indicated a reduction in average total uranium concentrations from previous quarters. These reductions reflect the reduced work activities in the Thorium/Plant 9 Complex as the dismantlement project neared completion (supplemental radiological air monitoring completed February 5, 1999). More detailed environmental data from the Thorium/Plant 9 Complex dismantlement project will be reported in the project completion report as specified in the Thorium/Plant 9 Complex Implementation Plan due in April 1999.

- Project-specific environmental radiological air monitoring for the dismantlement of the Sewage Treatment Plant Complex began during late June 1998 and continued through the fourth quarter. This monitoring program, consisting of biweekly total uranium and total particulate measurements, is conducted under the Sewage Treatment Plant Complex Implementation Plan for Above-Grade Decontamination and Dismantlement (DOE 1998f). The project-specific air monitor, STP-1, was installed just south of the sewage treatment plant, between AMS-3 and AMS-29 (refer to Figure 3-2). The monitor was located so that no obstructions were present between the monitor and the dismantlement project. The existence of an bermed tank in the Sewage Treatment Plant Complex precluded the placement of the monitor due east of the sewage treatment plant, which in the absence of the obstruction would have been the optimal location.

  Average total uranium concentrations at STP-1 decreased during the fourth quarter as compared to third quarter and year-to-date concentrations (refer to Table 3-2). The lower concentrations reflect the completion of the demolition of the incinerator and sewage treatment facility during the third quarter. As previously identified, the short-term increase in the total uranium concentration during November is attributed to on site remediation activities upwind of the STP-1 monitor (refer to Figure 3-10). This project monitor continues to operate and will remain in place until all excavation activities in the area of the sewage treatment plant have been completed.

  (Refer to Tables 3-1 and 3-2 and Figures 3-4 through 3-10 for data summaries and graphs.)

Air Particulate Monitoring Research Project

- During the fourth quarter of 1998, the DOE Environmental Measurements Laboratory (DOE-EML) continued to collect samples in order to measure the uranium concentration and particle size distribution of particulate emissions. Two samplers were in use during the fourth quarter: one was the established sampler described in previous IEMP reports and one was a new DOE-EML sampler with a higher flow rate. Both samplers experienced mechanical problems which required them to be removed from service midway through the fourth quarter. When repaired and returned to

service (expected to occur in early 1999), the new sampler should further improve the detection limit of the DOE-EML analyses. Additional progress on this research project will be included in future IEMP quarterly status reports.

Radon Monitoring

- As part of the radon monitoring program changes implemented in the IEMP, Revision 1, modifications were made during the fourth quarter of 1998 to the FEMP's network of continuous environmental radon monitors. Five additional monitors were collocated with air particulate monitoring stations along the site fenceline at AMS-08A, AMS-24, AMS-25, AMS-28, and AMS-29 (refer to Figure 3-11). The addition of these monitoring locations completes DOE's expansion of the fenceline network of continuous monitors, providing more timely assessment of environmental radon concentrations than the network of radon cups can provide. In December 1998 the Pit 5 radon monitoring location was removed from service. In addition, it should be noted that in January 1999, AMS-11 was removed from service and a radon monitoring location was added at building TS4 (within the former production area).

- As expected, the highest continuous environmental radon monitoring results were recorded at the K-65 exclusion fence resulting from radon emissions from the K-65 Silos. In general there has been a gradual increase in radon levels recorded at the exclusion fence corresponding to the increase in the K-65 Silo head space concentrations. All four K-65 exclusion fence monitors recorded higher monthly average radon levels than the same monthly periods in 1997. The maximum monthly average was 18.2 picoCuries per liter (pCi/L) and was recorded at location KNE. Year-to-date data indicate no exceedance of the DOE on site and fenceline annual average radon limits (30 and 3 pCi/L above background, respectively) for any radon monitoring locations. (Table 3-5 summarizes the monthly continuous environmental radon monitor concentration data.)

- Recognizing that K-65 Silo head space radon concentrations fluctuate seasonally due to changes in physical parameters (i.e., temperature, barometric pressure, humidity, etc.), concentrations are summarized quarterly (from the daily average concentrations) in an attempt to identify changes under similar meteorological conditions (refer to Figure 3-12). Fourth quarter 1998 monthly average continuous monitoring results for K-65 Silo 1 ranged between 13.6 and 13.8 million pCi/L. The quarterly average concentration increased approximately 17 percent over the quarterly average concentration during the same period in 1997 and is approximately 53 percent of the pre-bentonite concentration level (~26 million pCi/L). Fourth quarter 1998 monthly average continuous monitoring results for K-65 Silo 2 ranged between 8.32 and 9.36 million pCi/L. The quarterly average concentration increased approximately two percent over the average concentrations during the same period in 1997 and is approximately 29 percent of the pre-bentonite concentration level (~30 million pCi/L).

  It should be noted that radon emissions from the K-65 Silos will be mitigated through implementation of the Accelerated Waste Retrieval Project which includes the

construction of a radon treatment system for reducing radon concentrations in the silo head space. This activity is discussed in greater detail in the following bullet.

(Figure 3-12 shows the quarterly silo head space radon concentrations and Table 3-6 presents the monthly average silo head space radon concentrations.)

- During the fourth quarter of 1998, there was a noticeable increase in the number of exceedances of the DOE Order 5400.5 100 pCi/L radon limit recorded at the K-65 Silo exclusion fenceline (refer to Table 3-7). In response to the increasing radon concentrations in the vicinity of the K-65 Silos, DOE conducted detailed inspections of the silo domes using radiological survey instruments to pin point leak locations. As expected, leaks were found at the gasketed surfaces of manway flanges, sounding ports, and other silo penetrations. Radon was also found to be leaking from the covered access ports that were cut into the center protective cap of each silo to allow for the bentonite installation. The wooden port covers are approximately two foot wide and four foot in length and are fastened to the center cap using screws and an epoxy sealant. Over time the port covers have weathered, causing leakage at the seams. In an attempt to lower silo emissions from the port covers, DOE attached plastic coated tarps over each silo port cover using an adhesive and silicone based sealant. This maintenance activity was completed on December 17, 1998. Other maintenance activities are being evaluated based on the radiological survey data and are expected to be implemented in the spring of 1999.

  A more detailed analysis of interim and long-term control measures to lower silo radon emissions is currently in progress. As previously identified, the recommended long-term solution for controlling radon emissions from the silos encompassed within the Accelerated Waste Retrieval Project which includes the installation of a new radon control system. This system will initially draw head space air through activated carbon beds to remove radon then return the air back to the silos. A small stream of this cleaned air will be exhausted to the atmosphere to maintain the silos at a slight negative pressure to prevent further leakage. The system has been forecasted to become operational during 2001.

  DOE is currently evaluating the need to implement interim control measures until the radon control system is fully operational. The need for interim measures will be based largely on keeping work area exposures As Low As Reasonably Achievable. Alternatives (discussed in a January 12, 1999 conference call with EPA) are being considered for implementation in the event it becomes necessary to take action prior to radon control system operations. The advantages and disadvantages of the following three alternatives will be evaluated:

  - <u>Reseal the Residues</u>
    Reduces the radon emitted from the residues either by attempting to repair the bentonite seal or by adding additional material to act as a seal

- Reseal the Dome
  Contains the radon within the silos by identifying and repairing known leaks, followed by covering the dome with a spray-on coating and/or impermeable membrane

- Control Headspace Pressure
  Maintains a slight negative pressure in the head space, thus preventing uncontrolled releases by collecting a small amount of head space gas (approximately 10 cfm) per silo, removing the radon from it, then exhausting it to the atmosphere.

Direct Radiation (TLD) Monitoring

- All monitoring results from direct radiation measurements for the fourth quarter of 1998 were within historical ranges. Refer to Figure 3-13 for monitoring locations. As noted in the Integrated Environmental Monitoring Status Report for Second and Third Quarters 1998, a positive trend in the immediate area of the K-65 Silos (locations 22 through 26 have been identified and will continue to be monitored (refer to Figure 3-14). This trend is attributed to a corresponding increase in radon concentrations observed in the K-65 Silo head space. The increase in direct radiation measurements adjacent to the silos is still well below the levels observed prior to the addition of bentonite to the silos in 1991.

  A slight positive trend at the site fenceline nearest the K-65 Silos (location 6) is attributed to the corresponding increase in radon head space concentrations. Figure 3-15 shows the slight positive trend at location 6, the fenceline location which is closest to the K-65 Silos

  (Refer to Figures 3-13, 3-14, and 3-15 and Table 3-8.)

NESHAP Stack Emissions Monitoring

- Consistent with previous reporting, fourth quarter 1998 results for Building 71, Laboratory, and Laundry stacks are within expected ranges and no significant changes in the source operations associated with the stacks were noted. The T-Hopper stack was shut down on September 24, 1998, when the work activity requiring stack monitoring was completed.

  Typically, post production (1991 to present) stack monitoring results are near or below the minimum detectable concentration (MDC) levels for all isotopes monitored. Fourth quarter 1998 results are consistent with previous post production data with 33 percent of the filter samples analyzed indicating non-detectable levels (less than MDC) and the remainder indicating near MDC levels.

  Included in Table 3-9 are the results of the annual stack probe rinsate analyses. The probe rinsate samples measure the amount of radionuclides that have plated out inside

the stack probe and sample line over the year before reaching the stack filter. Results of the stack probe rinsate analyses are included in the 1998 year-to-date results for each stack.

(Figure 3-16 identifies the NESHAP stack emissions monitoring locations and Table 3-9 shows the stack monitoring results.)

The next IEMP quarterly status report, to be issued June 28, 1999, will include data from air monitoring activities from January through March 1999 (first quarter). Monitoring activities defined under the IEMP for radiological particulate, radon, direct radiation, and stack monitoring will continue as planned during the first quarter of 1999. Figure 3-17 shows the data from the air monitoring activities that will be included in the next IEMP quarterly status report.

TABLE 3-1

TOTAL URANIUM PARTICULATE CONCENTRATIONS IN AIR

Location[a]	1998 Year-to-Date Results[b] (pCi/m³ x 1E-6) No. of Samples	Min.	Max.	Avg.	Fourth Quarter 1998 Results[b] (pCi/m³ x 1E-6) No. of Samples	Min.	Max.	Avg.	Third Quarter 1998 Results[b] (pCi/m³ x 1E-6) No. of Samples	Min.	Max.	Avg.	1990 through 1997 Summary Results[c,d] (pCi/m³ x 1E-6) Min.	Max.
Fenceline														
AMS-2	26	11	168	62	7	14	82	55	6	33	165	92	0	3500
AMS-3	26	27	760	202	7	76	280	146	6	267	760	431	0	17000
AMS-4	26	7.7	78	32	7	21	57	33	6	11	78	47	0	2300
AMS-5	26	0	118	42	7	10	111	39	6	0	118	52	0	4400
AMS-6	26	2.7	235	47	7	11	42	28	6	33	86	59	0	3200
AMS-7	26	2.4	105	36	7	2.6	53	22	6	5.5	105	40	0	7800
AMS-8A	26	7.9	338	116	7	7.9	182	86	6	49	338	247	10	900
AMS-9C[e]	26	5.7	562	129	7	37	265	114	6	5.6	562	229	0	431
AMS-22	26	3.0	101	34	7	7.7	70	40	6	14	54	33	0	29
AMS-23	26	9.0	194	44	7	22	76	42	6	30	100	54	9.8	53
AMS-24	26	0	65	28	7	7.3	28	17	6	14	63	33	106	NA
AMS-25	26	0	79	30	7	0	41	16	6	0	79	34	6.7	30
AMS-26	26	0	98	40	7	0	97	33	6	0	89	51	0	41
AMS-27	25[f]	5.3	64	31	7	5.3	52	22	6	5.5	52	34	0	30
AMS-28	26	2.6	216	30	7	10	47	21	6	2.7	216	64	0	29
AMS-29	26	2.6	121	45	7	18	85	51	6	22	121	71	0	76
Background														
AMS-12	26	0	107	14	7	2.6	16	8.4	6	0	107	31	0	480
AMS-16	26	0	35	18	7	0	29	12	6	14	35	22	0	350
Project-Specific														
STP-1[g]	14	38	891	301	7	38	399	133	6	196	891	518	NA	NA

[a]See Figure 3-2
[b]For blank corrected concentrations less than or equal to 0.0 pCi/m³, the concentration is set as 0.0 pCi/m³.
[c]If the total number of samples is equal to one, then the data point is reported as the minimum.
[d]NA = not applicable
[e]Summary results for 1997 include AMS-9B/C data.
[f]One data point was not obtained due to a damaged filter.
[g]Project-specific monitor was not in operation prior to 1997.

TABLE 3-2

TOTAL PARTICULATE CONCENTRATIONS IN AIR

Location[a]	1998 Year-to-Date Results ($\mu g/m^3$)				Fourth Quarter 1998 Results ($\mu g/m^3$)				Third Quarter 1998 Results ($\mu g/m^3$)				1990 through 1997 Summary Results[b,c] ($\mu g/m^3$)	
	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	No. of Samples	Min.	Max.	Avg.	Min.	Max.
Fenceline														
AMS-2	25[d]	14	49	30	7	21	39	27	6	23	49	38	7.0	77
AMS-3	26	13	52	32	7	13	45	26	6	31	52	42	8.0	159
AMS-4	26	16	79	37	7	29	79	41	6	19	66	41	13	69
AMS-5	26	9.6	54	30	7	20	39	27	6	14	54	38	11	62
AMS-6	26	16	54	33	7	20	51	31	6	17	54	40	8.0	69
AMS-7	26	6.8	60	33	7	26	50	32	6	19	60	40	13	76
AMS-8A	26	13	64	34	7	21	47	31	6	15	64	42	18	89
AMS-9C[e]	26	15	65	36	7	23	44	31	6	17	65	46	7.1	136
AMS-22	26	13	57	34	7	32	43	37	6	16	57	37	21	30
AMS-23	26	15	51	30	7	20	37	26	6	15	51	36	22	28
AMS-24	26	18	79	42	7	24	51	33	6	25	59	45	74	NA
AMS-25	26	21	69	40	7	23	55	32	6	25	58	40	26	40
AMS-26	26	15	51	31	7	24	49	31	6	23	51	38	20	23
AMS-27	26	24	86	46	7	25	61	45	6	25	86	56	33	49
AMS-28	26	12	49	28	7	18	49	28	6	23	49	34	16	30
AMS-29	26	11	62	32	7	22	46	29	6	32	53	41	19	30
Background														
AMS-12[f]	26	12	47	28	7	19	45	26	6	26	47	35	6.0	416
AMS-16[f]	26	18	84	50	7	39	71	48	6	26	84	58	22	79
Project-Specific														
STP-1[g]	14	25	93	43	7	25	46	30	6	35	66	50	NA	NA

[a]See Figure 3-2
[b]If the total number of samples is equal to one, then the data point is reported as the minimum.
[c]NA = not applicable
[d]One data point was not obtained due to a damaged filter.
[e]Summary results for 1997 include AMS-9B/C data.
[f]Total particulate analysis was discontinued during 1994 and was reinstated for AMS-12 and AMS-16 in 1997.
[g]Project-specific monitor was not in operation prior to 1997.

TABLE 3-3

FOURTH QUARTER NESHAP COMPLIANCE TRACKING

	40 CFR 61 (NESHAP) Subpart H Appendix E, Table 2; Net Ratios[b]													
Location[a]	Actinium-228[c]	Radium-224[c]	Radium-226	Radium-228[c]	Thorium-228	Thorium-230	Thorium-231[c]	Thorium-232	Thorium-234[c]	Uranium-234	Uranium-235 Uranium-236	Uranium-238	Ratio Totals	Dose[d] (mrem)
Fenceline														
AMS-2	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00[e]	0.0E+00[e]	1.5E-09	0.0E+00[e]	3.4E-06	7.3E-04	5.8E-05	9.0E-04	1.7E-03	0.017
AMS-3	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.1E-09	0.0E+00	7.6E-06	2.2E-03	2.0E-04	2.0E-03	4.4E-03	0.044
AMS-4	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.1E-07	0.0E+00	0.0E+00	1.1E-04	1.1E-04	0.001
AMS-5	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-09	0.0E+00	5.4E-07	1.6E-04	4.5E-05	1.4E-04	3.4E-04	0.003
AMS-6	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-06	4.1E-04	0.0E+00	4.9E-04	9.0E-04	0.009
AMS-7	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.0E-10	0.0E+00	2.8E-07	5.3E-05	1.9E-05	7.3E-05	1.5E-04	0.001
AMS-8A	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00[e]	0.0E+00[e]	3.3E-09	0.0E+00[e]	5.7E-06	1.8E-03	1.3E-04	1.5E-03	3.4E-03	0.034
AMS-9C	6.5E-08	1.6E-06	1.8E-05	4.1E-05	5.1E-05	0.0E+00	3.8E-09	3.9E-04	8.6E-06	2.3E-03	1.5E-04	2.3E-03	5.2E-03	0.052
AMS-22	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-09	0.0E+00	2.3E-06	2.6E-04	4.6E-05	6.0E-04	9.1E-04	0.009
AMS-23	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.8E-10	0.0E+00	1.5E-06	4.6E-04	3.9E-05	4.1E-04	9.1E-04	0.009
AMS-24	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-07	6.8E-05	0.0E+00	5.0E-05	1.2E-04	0.001
AMS-25	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.000
AMS-26	0.0E+00	0.0E+00	1.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-06	4.3E-04	0.0E+00	5.1E-04	1.1E-03	0.011
AMS-27	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E-07	8.0E-06	0.0E+00	4.0E-05	4.8E-05	0.000
AMS-28	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.000
AMS-29	0.0E+00	0.0E+00	2.0E-04	0.0E+00	0.0E+00	0.0E+00	1.7E-09	0.0E+00	2.2E-06	4.7E-04	6.5E-05	5.8E-04	1.3E-03	0.013
Background														
AMS-12	0.0E+00	0.0E+00	5.8E-04	0.0E+00	0.0E+00[e]	0.0E+00[e]	0.0E+00	0.0E+00[e]	0.0E+00	0.0E+00[e]	0.0E+00[e]	0.0E+00[e]	NA[f]	
AMS-16	7.9E-07	2.0E-05	1.4E-03	5.0E-04	1.3E-03	1.3E-03	0.0E+00	4.7E-03	1.8E-06	5.9E-04	0.0E+00	4.8E-04	NA[f]	

Maximum Quarterly Ratio: 0.0052
Maximum Quarterly Dose (mrem): 0.052

[a]See Figure 3-2
[b]A ratio of 0.0+00 indicates the filter results were less than or equal to the blank results, and/or the indicator concentrations were less than or equal to the average net background concentrations.
[c]Isotopes assumed to be in equilibrium with their parents.
[d]Dose conversions are based on the NESHAP standard of 10 mrem per year.
[e]Through the validation process, fourth quarter data were rejected due to low tracer recoveries. Rejected data were not used in dose calculations.
[f]NA = not applicable

TABLE 3-4

YEAR-TO-DATE NESHAP COMPLIANCE TRACKING

	40 CFR 61 (NESHAP) Subpart H Appendix E, Table 2; Net Ratios[b]													
Location[a]	Actinium-228[c]	Radium-224[c]	Radium-226	Radium-228[c]	Thorium-228	Thorium-230	Thorium-231[c]	Thorium-232	Thorium-234[c]	Uranium-234	Uranium-235 Uranium-236	Uranium-238	Ratio Totals	Dose[d] (mrem)
Fenceline														
AMS-2	0.0E+00	0.0E+00	4.9E-04	0.0E+00	0.0E+00[e]	0.0E+00[e]	5.4E-08	0.0E+00[e]	1.4E-05	3.4E-03	2.1E-03	3.7E-03	9.7E-03	0.097
AMS-3	0.0E+00	0.0E+00	2.4E-03	0.0E+00	0.0E+00	4.3E-04	2.4E-08	0.0E+00	3.8E-05	1.1E-02	9.3E-04	1.0E-02	2.5E-02	0.25
AMS-4	0.0E+00	0.0E+00	4.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-06	4.3E-04	0.0E+00	6.5E-04	1.6E-03	0.016
AMS-5	0.0E+00	0.0E+00	3.9E-04	0.0E+00	0.0E+00	1.4E-04	1.3E-08	0.0E+00	4.9E-06	1.3E-03	5.2E-04	1.3E-03	3.7E-03	0.037
AMS-6	0.0E+00	0.0E+00	1.2E-03	0.0E+00	0.0E+00	0.0E+00	5.3E-09	0.0E+00	5.9E-06	1.5E-03	2.1E-04	1.6E-03	4.5E-03	0.045
AMS-7	8.5E-09	2.1E-07	9.6E-04	5.3E-06	0.0E+00	0.0E+00	3.6E-09	5.1E-05	3.7E-06	1.1E-03	1.4E-04	9.9E-04	3.2E-03	0.032
AMS-8A	0.0E+00	0.0E+00	6.6E-04	0.0E+00	0.0E+00[e]	1.2E-04[e]	2.2E-08	0.0E+00[e]	2.7E-05	7.9E-03	8.6E-04	7.2E-03	1.7E-02	0.17
AMS-9C	4.6E-07	1.1E-05	4.7E-04	2.9E-04	6.4E-04	3.9E-04	4.3E-08	2.8E-03	3.3E-05	8.9E-03	1.7E-03	8.9E-03	2.4E-02	0.24
AMS-22	0.0E+00	0.0E+00	5.4E-04	0.0E+00	0.0E+00	3.1E-04	1.2E-08	0.0E+00	4.6E-06	9.6E-04	4.6E-04	1.2E-03	3.5E-03	0.035
AMS-23	0.0E+00	0.0E+00	9.6E-05	0.0E+00	0.0E+00	3.3E-05	1.6E-08	0.0E+00	9.5E-06	2.2E-03	6.4E-04	2.5E-03	5.5E-03	0.055
AMS-24	3.8E-07	9.5E-06	1.5E-04	2.4E-04	2.3E-04	6.5E-04	3.6E-09	2.3E-03	2.8E-06	7.2E-04	1.4E-04	7.5E-04	5.2E-03	0.052
AMS-25	6.0E-07	1.5E-05	6.0E-04	3.8E-04	3.7E-04	4.3E-03	9.9E-09	3.6E-03	3.1E-06	7.6E-04	3.9E-04	8.2E-04	1.1E-02	0.11
AMS-26	0.0E+00	0.0E+00	1.6E-04	0.0E+00	0.0E+00	0.0E+00	1.4E-08	0.0E+00	6.9E-06	1.7E-03	5.5E-04	1.8E-03	4.2E-03	0.042
AMS-27	1.5E-07	3.7E-06	8.5E-04	9.3E-05	0.0E+00	2.7E-04	4.7E-09	8.9E-04	2.7E-06	6.7E-04	1.9E-04	7.1E-04	3.7E-03	0.037
AMS-28	0.0E+00	0.0E+00	3.6E-04	0.0E+00	0.0E+00	0.0E+00	2.0E-09	0.0E+00	1.6E-06	3.8E-04	8.0E-05	4.2E-04	1.2E-03	0.012
AMS-29	0.0E+00	0.0E+00	2.0E-04	0.0E+00	0.0E+00	1.5E-04	6.4E-09	0.0E+00	7.1E-06	1.7E-03	2.5E-04	1.9E-03	4.2E-03	0.042
Background														
AMS-12	1.3E-06	3.2E-05	2.0E-03	8.1E-04	1.7E-03[e]	1.7E-03[e]	1.8E-09	7.7E-03[e]	4.6E-06	1.2E-03[e]	6.9E-05[e]	1.2E-03[e]	NA[f]	
AMS-16	3.2E-06	7.8E-05	1.4E-03[g]	2.0E-03	4.6E-03	4.9E-03	9.2E-10	1.9E-02	6.9E-06	2.0E-03	3.6E-05	1.8E-03	NA[f]	

Maximum Year-to-Date Ratio: 0.025
Maximum Year-to-Date Dose (mrem): 0.25

[a]See Figure 3-2
[b]A ratio of 0.0+00 indicates the filter results were less than or equal to the blank results, and/or the indicator concentrations were less than or equal to the average net background concentrations.
[c]Isotopes assumed to be in equilibrium with their parents.
[d]Dose conversions are based on the NESHAP standard of 10 mrem per year.
[e]Through the validation process, fourth quarter data were rejected due to low tracer recoveries. Rejected data were not used in dose calculations.
[f]NA = not applicable
[g]The validated third quarter result was not considered representative of true background radium-226 concentrations at AMS-16. Therefore, the result was not used in dose calculations.

TABLE 3-5

CONTINUOUS ENVIRONMENTAL RADON MONITORING MONTHLY AVERAGE CONCENTRATIONS

	Fourth Quarter 1998 Monthly Results[b,c] (Instrument Background Corrected) (pCi/L)			1998 Year-to-Date Results[b,c] (Instrument Background Corrected) (pCi/L)			1997 Summary Results[b,c] (Instrument Background Corrected) (pCi/L)		
Location[a]	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
Fenceline									
AMS-02	0.5	0.7	0.6	0.2	0.7	0.4	0.3	0.7	0.5
AMS-03[d]	0.6	0.8	0.7	0.6	0.8	0.7	NA	NA	NA
AMS-04	0.4	0.6	0.5	0.1	0.7	0.4	0.1	0.7	0.4
AMS-05	0.7	1.0	0.8	0.2	1.3	0.6	0.1	1.2	0.5
AMS-06	0.6	0.9	0.7	0.2	0.9	0.5	0.2	0.8	0.4
AMS-07	0.9	1.2	1.0	0.2	1.5	0.7	0.1	1.2	0.5
AMS-08A[e]	0.8	NA	NA	0.8	NA	NA	NA	NA	NA
AMS-09C[f]	0.5	0.7	0.6	0.2	0.9	0.6	NA	NA	NA
AMS-22[f]	0.4	0.6	0.5	0.2	0.7	0.4	NA	NA	NA
AMS-23[d]	0.4	0.5	0.4	0.4	0.5	0.4	NA	NA	NA
AMS-24[e]	0.7	NA	NA	0.7	NA	NA	NA	NA	NA
AMS-25[e]	0.6	NA	NA	0.6	NA	NA	NA	NA	NA
AMS-26[f]	0.5	0.7	0.6	0.2	0.8	0.6	NA	NA	NA
AMS-27[f]	0.6	0.9	0.7	0.2	1.1	0.7	NA	NA	NA
AMS-28[e]	0.4	NA	NA	0.4	NA	NA	NA	NA	NA
AMS-29[e]	0.7	NA	NA	0.7	NA	NA	NA	NA	NA
Off Site									
AMS-11	0.6	0.7	0.6	0.1	1.0	0.4	0.1	0.9	0.4
Background									
AMS-12	0.4	0.5	0.4	0.1	0.6	0.3	0.0	0.5	0.2
AMS-16	0.3	0.5	0.4	0.2	0.6	0.4	0.1	0.4	0.2
On Site									
KNE	16.4	18.2	17.6	2.0	18.2	9.1	2.9	7.4	5.5
KNW	3.1	4.8	4.1	1.0	4.8	2.4	0.9	2.3	1.6
KSE	14.1	16.9	15.2	2.4	16.9	8.3	2.8	11.6	5.6
KSW	4.5	5.2	4.9	1.4	5.2	3.1	1.5	3.3	2.3
KTOP	13.6	24.6	19.8	7.2	24.6	13.0	6.0	13.5	9.9
Pilot Plant Warehouse	0.6	0.9	0.7	0.1	0.9	0.4	0.1	1.2	0.4
Pit 5	0.8	1.0	0.9	0.2	1.0	0.5	0.2	0.9	0.5
Rally Point 4	1.1	1.3	1.2	0.2	1.3	0.7	0.3	1.0	0.6
Surge Lagoon	1.1	1.3	1.2	0.3	1.3	0.7	0.3	1.3	0.7
T28	2.2	2.8	2.6	0.9	2.8	1.8	1.0	2.4	1.8
WP-17A	0.6	0.9	0.7	0.2	0.9	0.5	0.2	1.0	0.5

[a]See Figure 3-11
[b]Instrument background changes as monitors are replaced.
[c]NA = not applicable
[d]Unit was placed in service in August 1998.
[e]Unit was placed in service in December 1998.
[f]Unit was placed in service in June 1998.

TABLE 3-6

RADON HEAD SPACE CONCENTRATIONS

	Radon Head Space Concentrations[a,b,c] (pCi/L)											
	Silo 1 1998			Silo 1 1997			Silo 2 1998			Silo 2 1997		
Month	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.	Min.	Max.	Avg.
January	1.06E+07	1.18E+07	1.13E+07	9.23E+06	1.09E+07	9.90E+06	8.24E+06	1.01E+07	9.10E+06	7.05E+06	8.63E+06	7.74E+06
February	1.06E+07	1.18E+07	1.12E+07	9.02E+06	1.03E+07	9.67E+06	8.02E+06	9.48E+06	8.96E+06	6.06E+06	7.94E+06	7.01E+06
March	1.01E+07	1.17E+07	1.10E+07	8.40E+06	9.76+06	9.16E+06	7.27E+06	9.19E+06	8.45E+06	5.66E+06	6.31E+06	6.01E+06
April	9.89E+06	1.09E+07	1.05E+07	7.87E+06	8.70E+06	8.33E+06	7.34E+06	8.87E+06	8.14E+06	5.48E+06	6.33E+06	5.99E+06
May	1.05E+07	1.20E+07	1.10E+07	7.65E+06	8.45E+06	8.06E+06	8.38E+06	8.99E+06	8.62E+06	5.71E+06	6.45E+06	6.05E+06
June	1.08E+07	1.22E+07	1.15E+07	7.77E+06	9.12E+06	8.51E+06	8.25E+06	9.05E+06	8.62E+06	6.14E+06	8.36E+06	7.10E+06
July	1.20E+07	1.41E+07	1.29E+07	8.86E+06	9.55E+06	9.16E+06	8.79E+06	9.44E+06	9.06E+06	8.11E+06	8.47E+06	8.31E+06
August	1.34E+07	1.43E+07	1.39E+07	9.29E+06	1.01E+07	9.72E+06	8.73E+06	9.08E+06	8.93E+06	7.80E+06	8.59E+06	8.13E+06
September	1.23E+07	1.42E+07	1.31E+07	9.49E+06	1.06E+07	1.00E+07	7.78E+06	8.79E+06	8.15E+06	6.29E+06	7.73E+06	6.70E+06
October	1.32E+07	1.43E+07	1.38E+07	9.87E+06	1.24E+07	1.12E+07	7.85E+06	8.94E+06	8.32E+06	7.23E+06	8.91E+06	7.99E+06
November	1.34E+07	1.43E+07	1.38E+07	1.14E+07	1.27E+07	1.20E+07	7.90E+06	9.30E+06	8.68E+06	7.75E+06	9.25E+06	8.67E+06
December	1.29E+07	1.43E+07	1.36E+07	1.13E+07	1.24E+07	1.18E+07	7.96E+06	1.09E+07	9.36E+06	8.05E+06	1.01E+07	9.12E+06

[a]Minimum equals minimum recorded daily average radon concentration.
[b]Maximum equals maximum recorded daily average radon concentration.
[c]Average equals monthly average of recorded daily radon concentrations.

TABLE 3-7

1998 FOURTH QUARTER RADON CONCENTRATIONS
100 pCi/L EXCEEDANCES AT THE K-65 SILOS 1 AND 2 EXCLUSION FENCE

Exceedance Event Start Date	Duration of Exceedance (hours)	Maximum Radon Concentration (pCi/L)	Monitoring Location[a]
10/12	1	101.1	KSE
10/12	4	169.4	KSE
10/17	4	190.3	KNE
10/24	4	138.9	KNE
10/25	6	143.5	KNE
10/26	1	113.7	KNE
10/27	2	112.7	KNE
10/29	1	102.2	KNE
11/12	6	229.7	KNE
11/13	6	151.6	KNE
11/15	4	155.9	KNE
11/21	10	144.7	KNE
11/24	13	149.2	KNE
12/1	7	257.8	KNE
12/9	10	190.7	KNE
12/11	1	101.6	KNE
12/15	10	158.4	KNE
12/24	2	186.4	KNE
12/25	7	200.8	KSE
12/26	5	163.4	KNE

[a]See Figure 3-11

TABLE 3-8

DIRECT RADIATION (TLD) MEASUREMENTS

Location[a]	Direct Radiation ± Uncertainty[b] (mrem)		
	Fourth Quarter 1998 Results	Year-to-Date 1998 Results[c]	1997 Summary Results
Fenceline			
2	19 ± 2.4	74 ± 12	72 ± 10
3	17 ± 2.1	67 ± 11	65 ± 9.0
4	17 ± 2.1	66 ± 11	65 ± 9.1
5	18 ± 2.2	68 ± 11	67 ± 9.3
6	20 ± 2.5	84 ± 14	79 ± 11
7	17 ± 2.1	69 ± 11	65 ± 9.0
8A	19 ± 2.3	75 ± 12	74 ± 10
9C	21 ± 2.6	79 ± 13	79 ± 11[d]
13	19 ± 2.3	74 ± 12	71 ± 9.9
14	19 ± 2.3	77 ± 12	70 ± 9.8
15	20 ± 2.5	79 ± 13	74 ± 10
16	21 ± 2.6	81 ± 13	77 ± 11
17	19 ± 2.4	73 ± 12	70 ± 9.7
34[e]	19 ± 2.4	75 ± 12	73 ± 14
35[e]	18 ± 2.2	70 ± 11	67 ± 13
36[e]	17 ± 2.1	65 ± 11	60 ± 12
37[e]	19 ± 2.4	77 ± 12	75 ± 14
38[e]	16 ± 2.0	63 ± 10	60 ± 11
39[e]	20 ± 2.5	79 ± 13	76 ± 14
40[e]	17 ± 2.1	67 ± 11	65 ± 12
41[e]	19 ± 2.4	73 ± 12	70 ± 13
Min.	**16 ± 2.0**	**63 ± 10**	**60 ± 12**
Max.	**21 ± 2.6**	**84 ± 14**	**79 ± 11[d]**
On Site			
1B	23 ± 2.8	89 ± 14	84 ± 12
22	206 ± 26	776 ± 125	778 ± 108
23	239 ± 30	817 ± 132	712 ± 99
24	174 ± 22	632[f] ± 102	512 ± 71
25	177 ± 22	698 ± 113	641 ± 89
26	124 ± 15	496 ± 80	425 ± 59
32	14 ± 1.7	55 ± 9.0	54 ± 7.5
Min.	**14 ± 1.7**	**55 ± 9.0**	**54 ± 7.5**
Max.	**239 ± 30**	**817 ± 132**	**778 ± 108**

TABLE 3-8
(Continued)

Location[a]	Direct Radiation ± Uncertainty[b] (mrem)		
	Fourth Quarter 1998 Results	Year-to-Date 1998 Results[c]	1997 Summary Results
Off Site			
10	14 ± 1.8	56 ± 9.1	52 ± 7.3
11	17 ± 2.1	69 ± 11	65 ± 9.1
12	15 ± 1.9	62 ± 10	59 ± 8.2
30	15 ± 1.9	62 ± 9.9	59 ± 8.2
Min.	**14 ± 1.8**	**56 ± 9.1**	**52 ± 7.3**
Max.	**17 ± 2.1**	**69 ± 11**	**65 ± 9.1**
Background			
18	19 ± 2.4	77 ± 13	74 ± 10
19	17 ± 2.1	65 ± 10	60 ± 8.4
20	16 ± 2.0	61 ± 9.9	57 ± 8.0
21	17[g] ± 2.1	69[g] ± 11	67 ± 9.4
27	16 ± 2.0	64 ± 10	60 ± 8.3
33	17 ± 2.1	68 ± 11	65 ± 9.1
Min.	**16 ± 2.0**	**61 ± 9.9**	**57 ± 8.0**
Max.	**19 ± 2.4**	**77 ± 13**	**74 ± 10**

[a]See Figure 3-13
[b]Associated laboratory uncertainty
[c]Uncertainty terms for second quarter are based on average uncertainty from previous quarters. Due to an error in the laboratory, the TLDs used to determine the uncertainty were not processed.
[d]Locations 9B and 9C are combined to determine 1997 year end results.
[e]1997 data for locations 34 through 41 are calculated from fourth quarter (October through December) measurement. These locations were established during the fourth quarter of 1997.
[f]Direct radiation and uncertainty value includes estimated second quarter results which were based on first quarter results.
[g]Direct radiation and uncertainty value includes estimated fourth quarter data based on the average of the previous three quarters.

TABLE 3-9

NESHAP STACK EMISSION MONITORING RESULTS

	Fourth Quarter Results		Annual Rinsate Results		1998 Year-to-Date Results	
Analysis Performed	No. of Samples	Total Pounds[a,b]	No. of Samples	Total Pounds[a]	No. of Samples	Total Pounds[a]
Building 71 Stack						
Uranium, Total	1	ND	1	8.2E-06	5	1.3E-05
Thorium-232	1	2.0E-05	1	6.6E-05	5	8.6E-05
Thorium-230	1	4.5E-10	1	6.9E-10	5	1.2E-09
Total Particulate	NA[c]	NA	1	7.2E-02	1[c]	7.2E-02
Laboratory Stack						
Uranium, Total	1	ND	1	1.0E-04	5	1.0E-04
Thorium-232	1	9.5E-05	1	2.7E-04	5	4.2E-04
Thorium-230	1	1.1E-09	1	3.0E-09	5	5.1E-09
Total Particulate	1	2.2E-01	1	1.5E-01	5	1.2E+00
Laundry Stack						
Uranium, Total	1	ND	1	7.0E-06	10	7.0E-06
Thorium-232	1	8.5E-05	1	1.9E-04	10	4.5E-04
Thorium-230	1	8.3E-10	1	3.0E-09	10	5.8E-09
Total Particulate	1	2.3E-01	1	3.5E-02	8[c]	1.1E+00
T-Hopper Stack[d]						
Uranium, Total	NS	NS	1	2.5E-04	6	5.9E-04
Thorium-232	NS	NS	1	2.1E-04	6	4.5E-04
Thorium-230	NS	NS	1	2.8E-09	6	5.2E-09
Total Particulate	NS	NS	1	7.8E-01	2[c]	8.0E-01

[a]Total pounds are only determined from detected results.
[b]ND = non-detectable
NA = not available
[c]Total particulate result(s) could not be determined due to a damaged filter(s).
[d]NS = not sampled because T-Hopper Stack was not in operation during the fourth quarter.

FIGURE 3-1

AIR SAMPLING ACTIVITIES COVERED IN THIS QUARTERLY REPORT

SAMPLING ACTIVITIES	1998											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Radiological Particulate Monitoring:										♦	♦	♦
NESHAP Quarterly Composite												♦
Radon Monitoring - Continuous Alpha Scintillation Monitors										♦	♦	♦
Radon Monitoring - Alpha Track-Etch Cups												
Direct Radiation (TLD) Monitoring												♦
NESHAP Stack Emissions Monitoring										♦	♦	♦

♦ Data summarized/ evaluated in this report

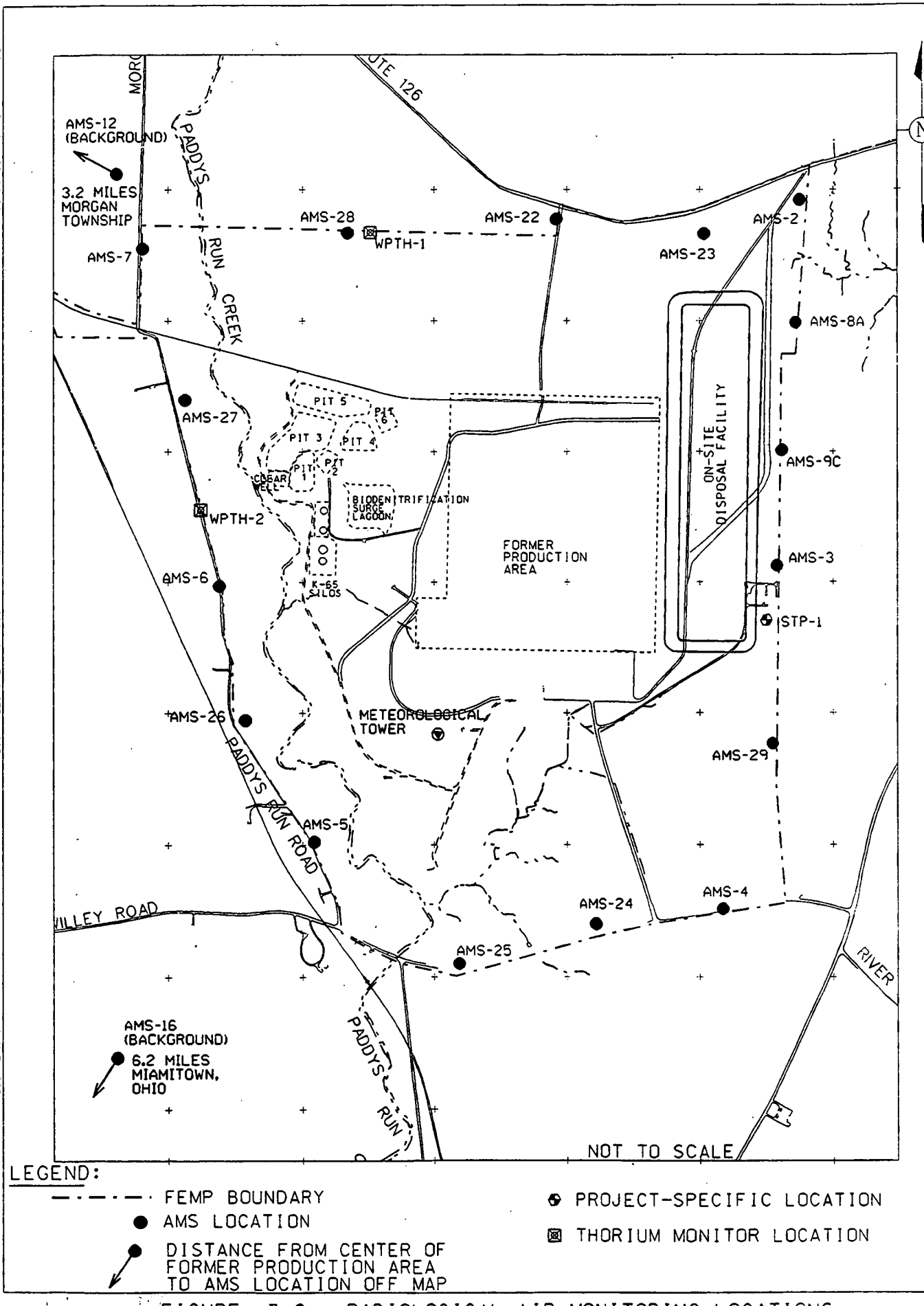
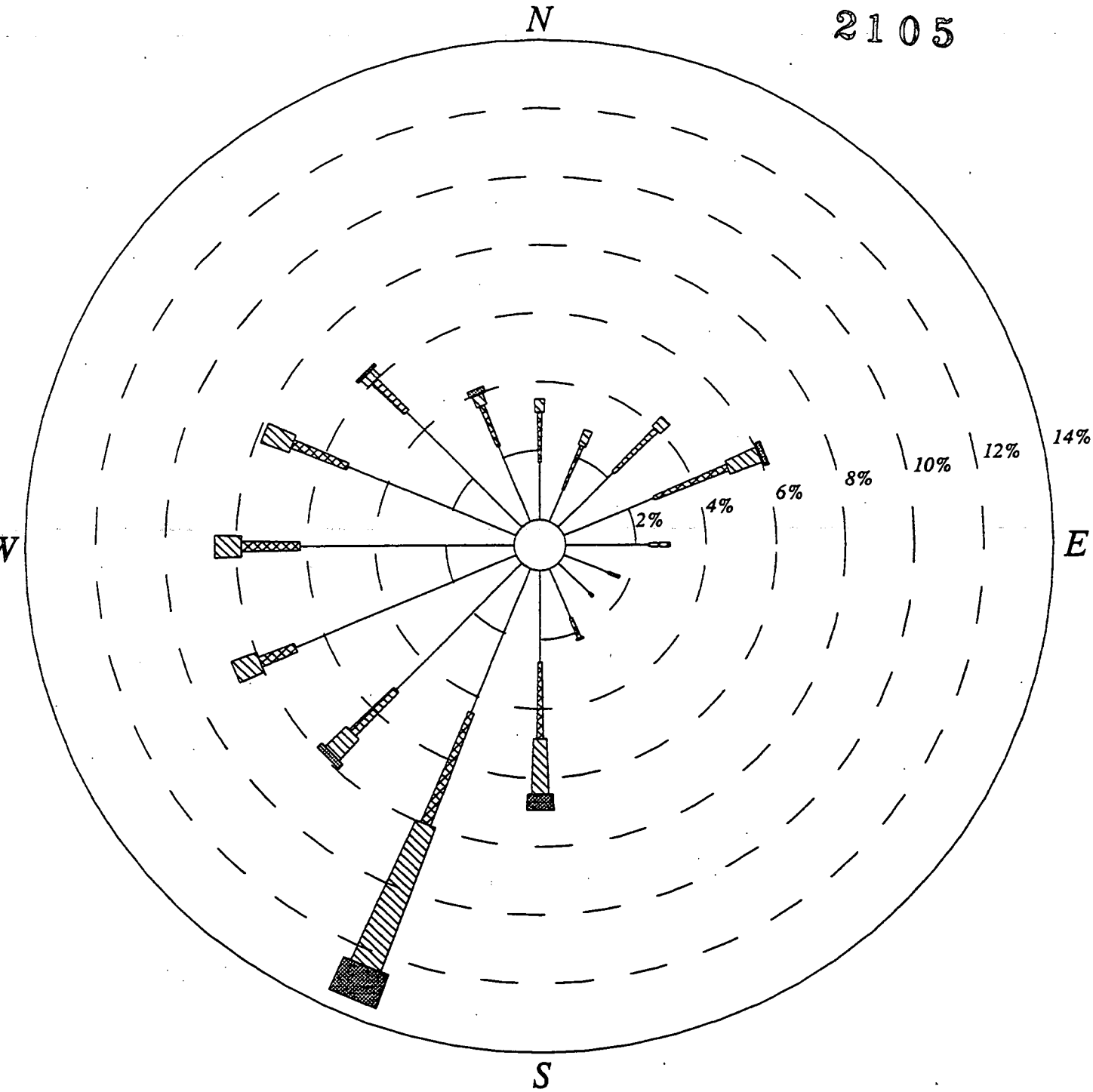


FIGURE 3-2. RADIOLOGICAL AIR MONITORING LOCATIONS



CALM WINDS 10.73%

NOTE: Frequencies indicate direction from which the wind is blowing.

WIND SPEED (KNOTS)

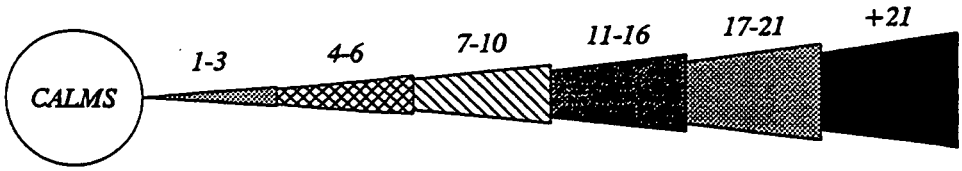


FIGURE 3-3. FOURTH QUARTER 1998 WIND ROSE DATA, 10-METER HEIGHT

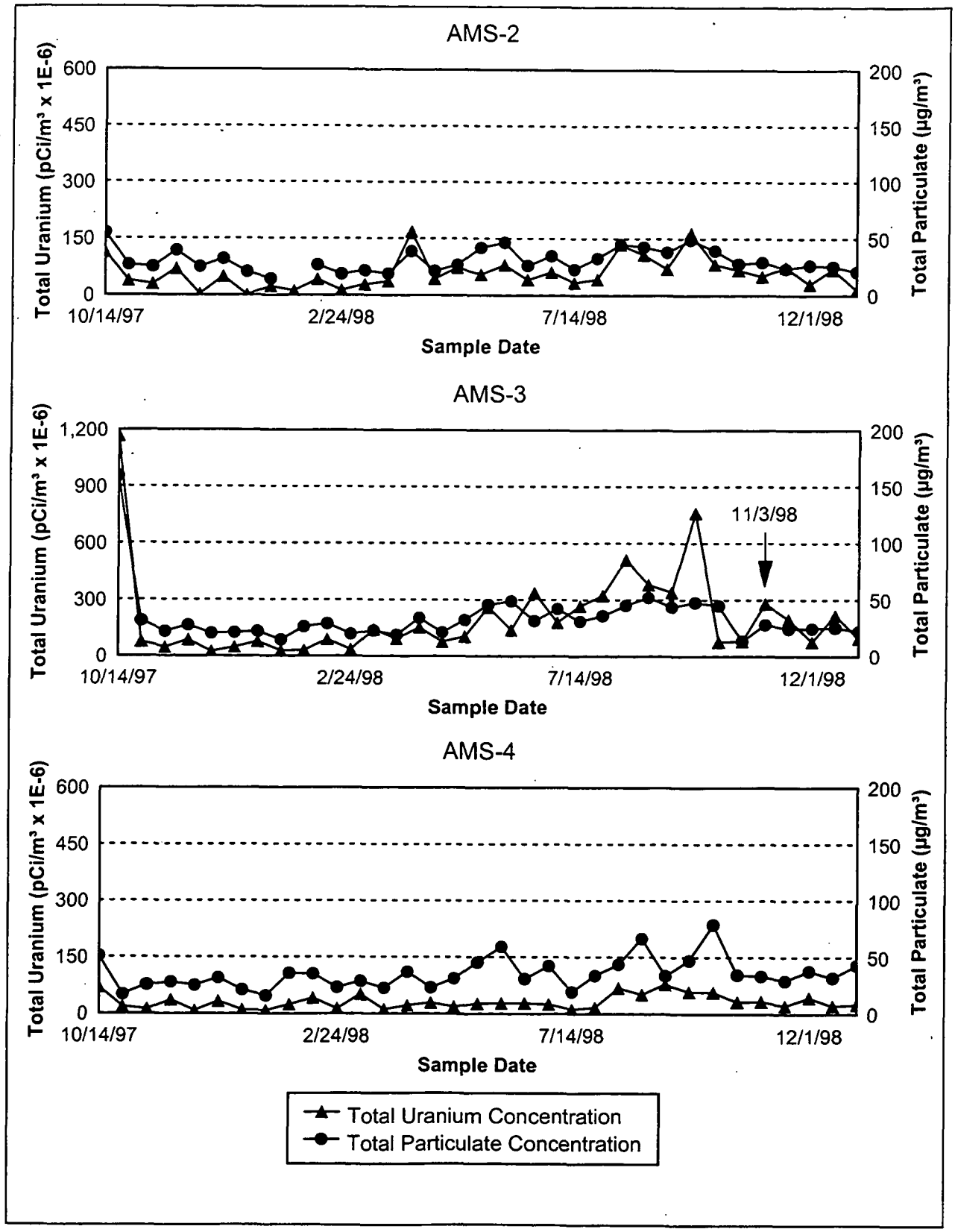


FIGURE 3-4. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-2, AMS-3, AND AMS-4)

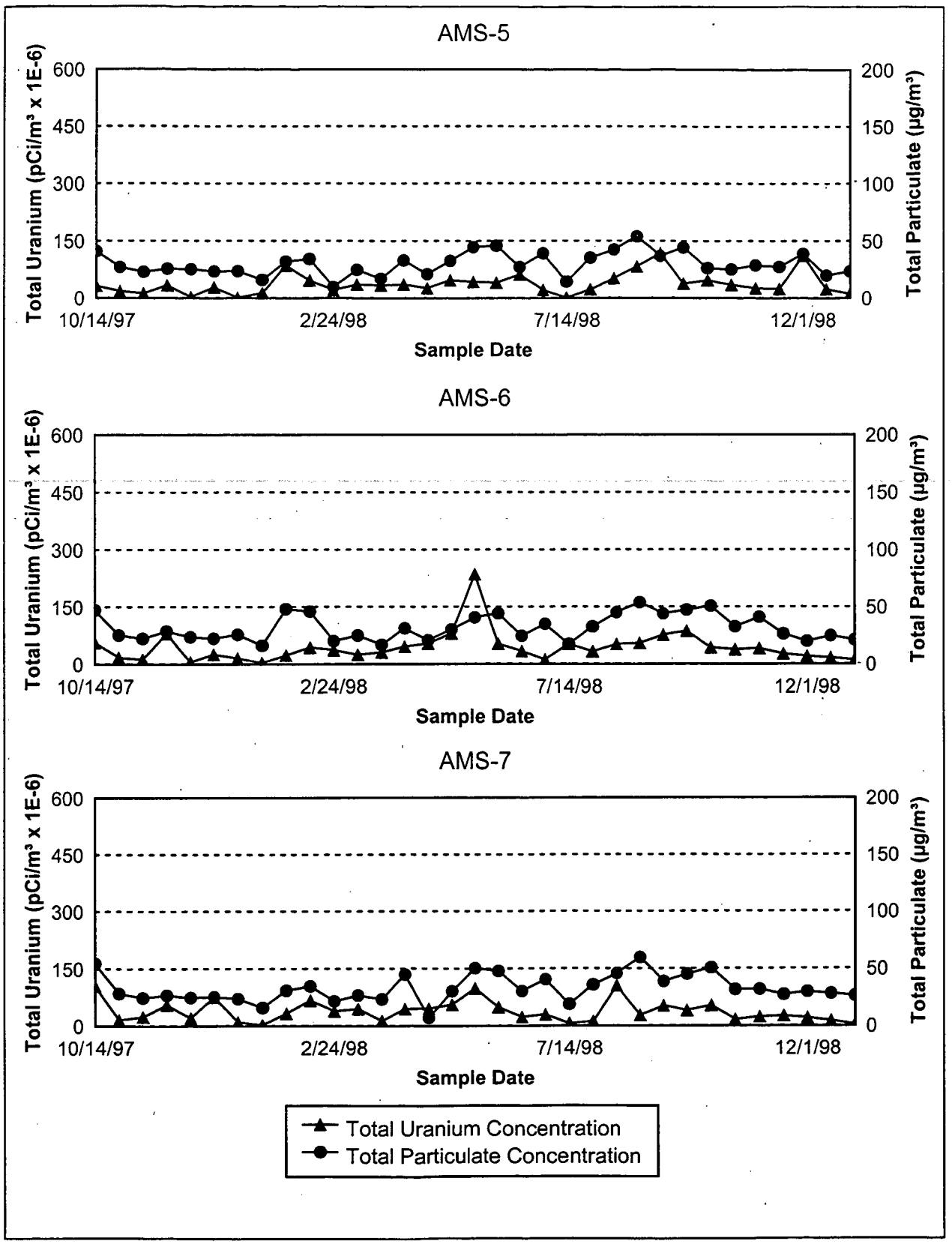


FIGURE 3-5. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-5, AMS-6, AND AMS-7)

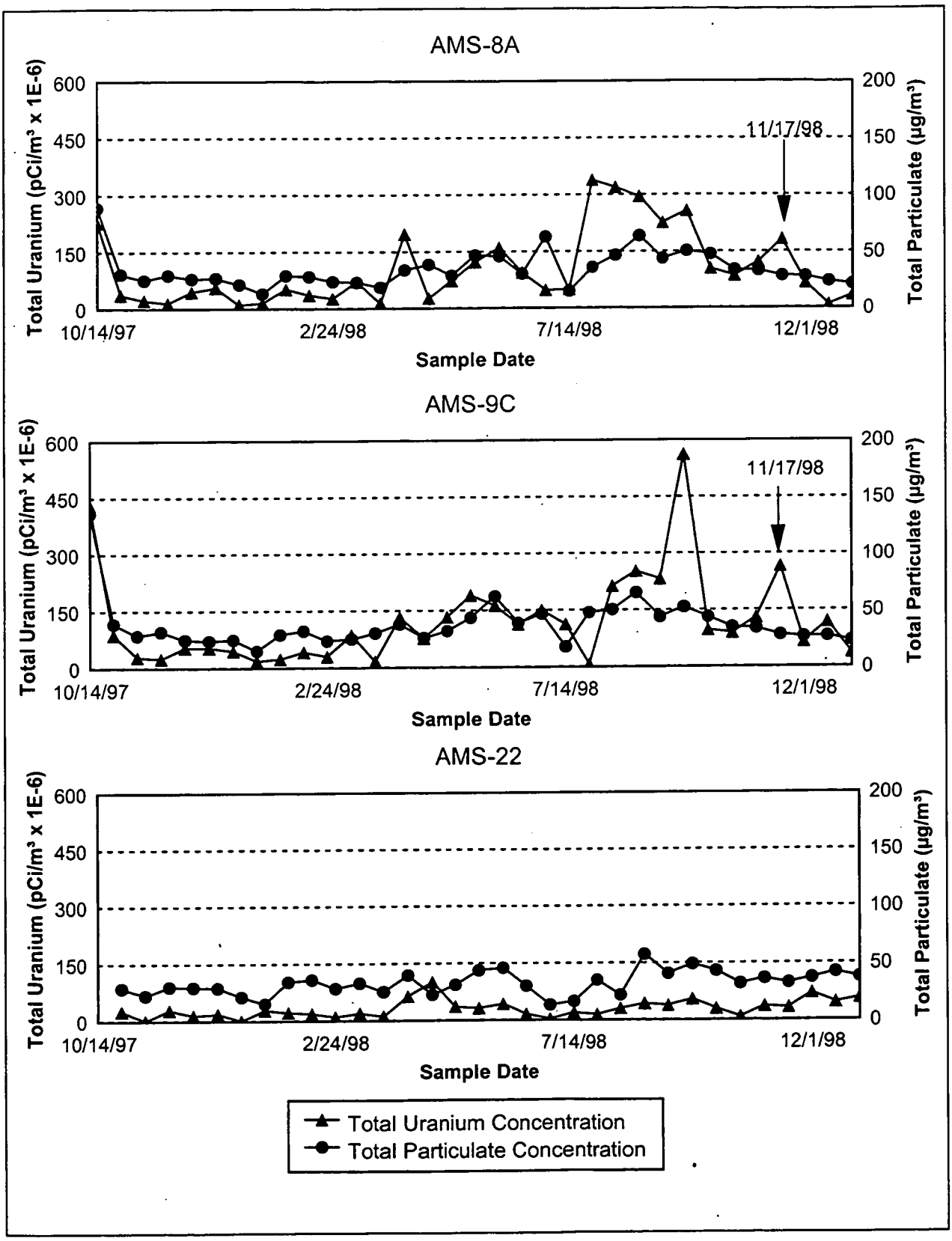


FIGURE 3-6. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-8A, AMS-9C, AND AMS-22)

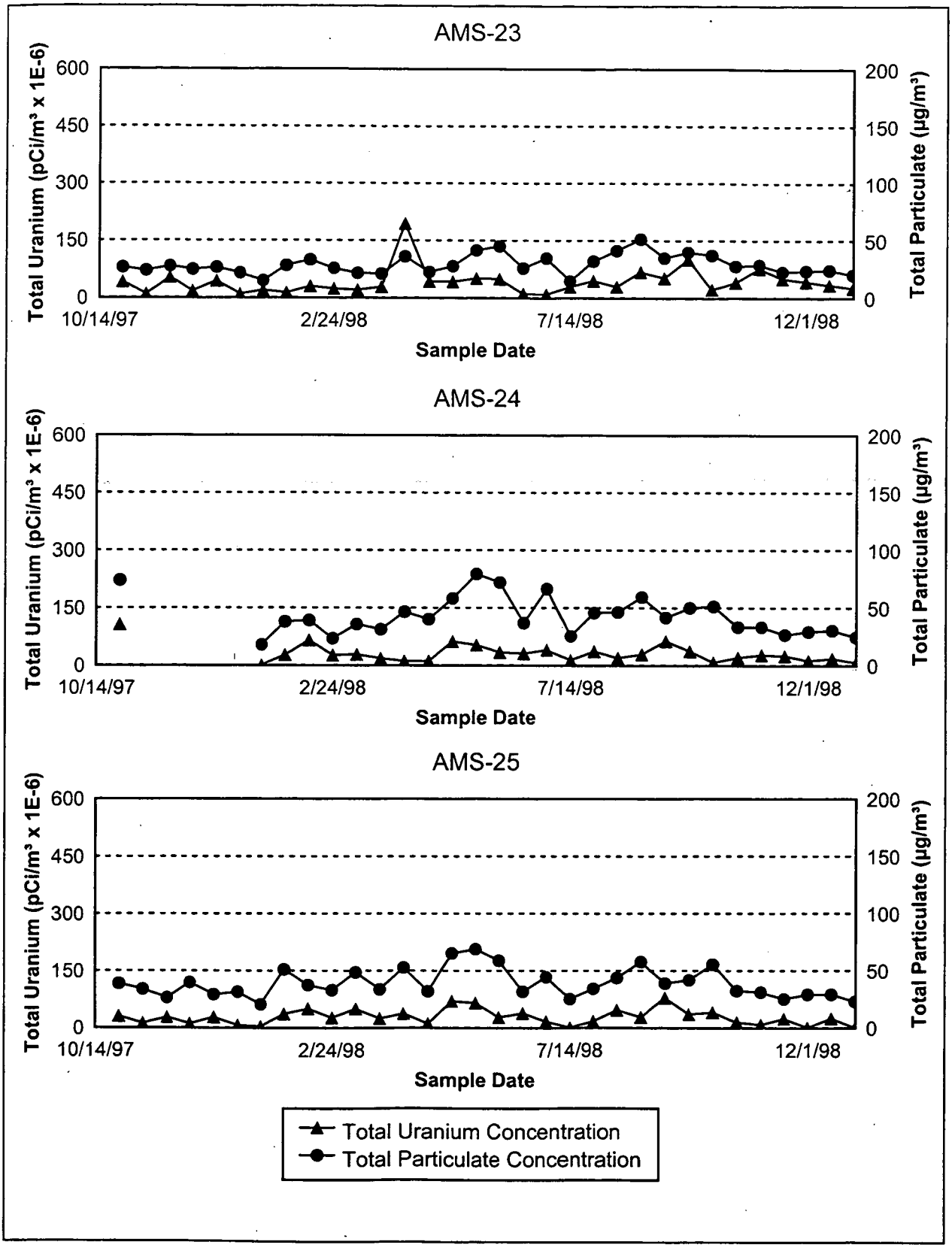


FIGURE 3-7. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-23, AMS-24, AND AMS-25)

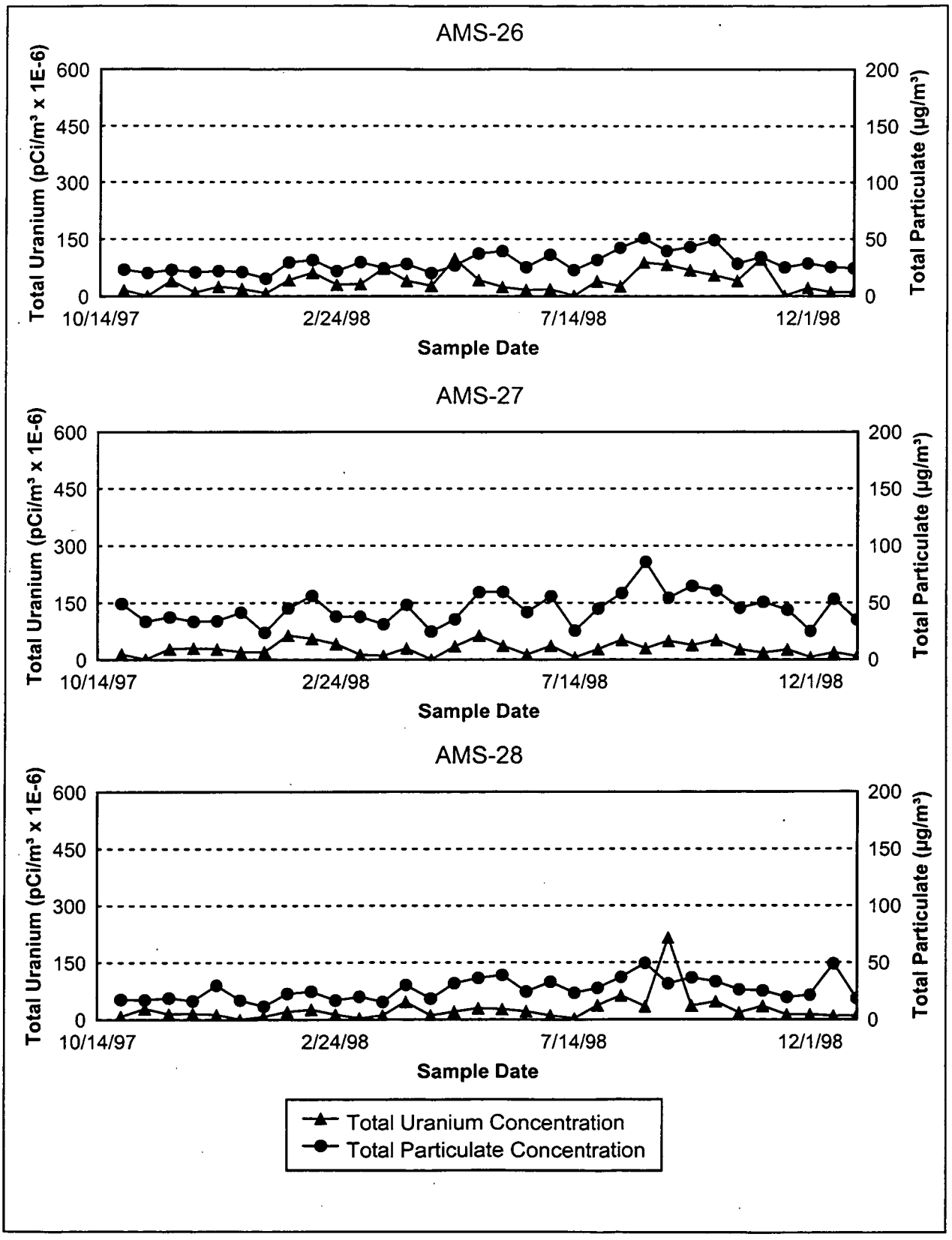


FIGURE 3-8. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-26, AMS-27, AND AMS-28)

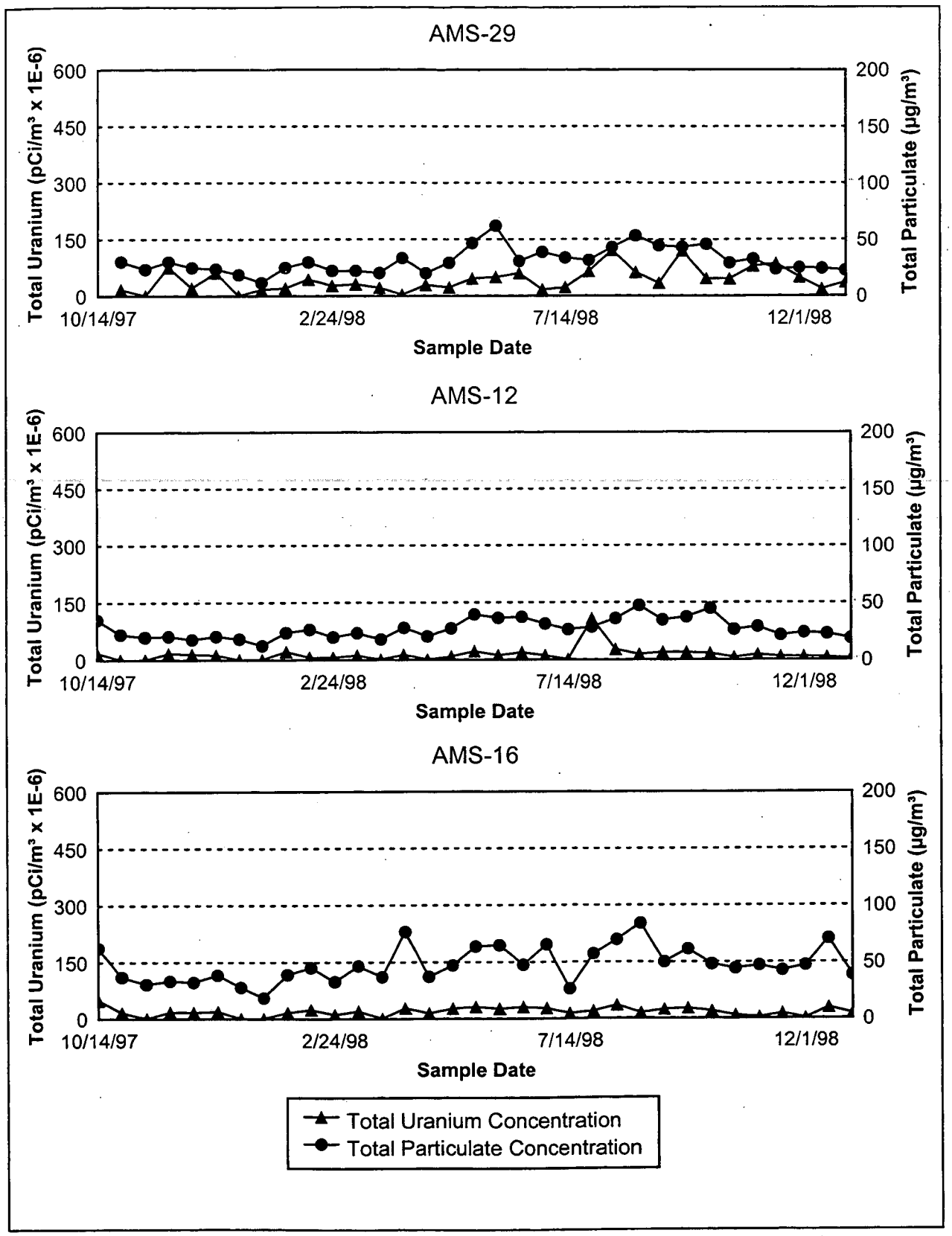


FIGURE 3-9. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (AMS-29, AMS-12, AND AMS-16)

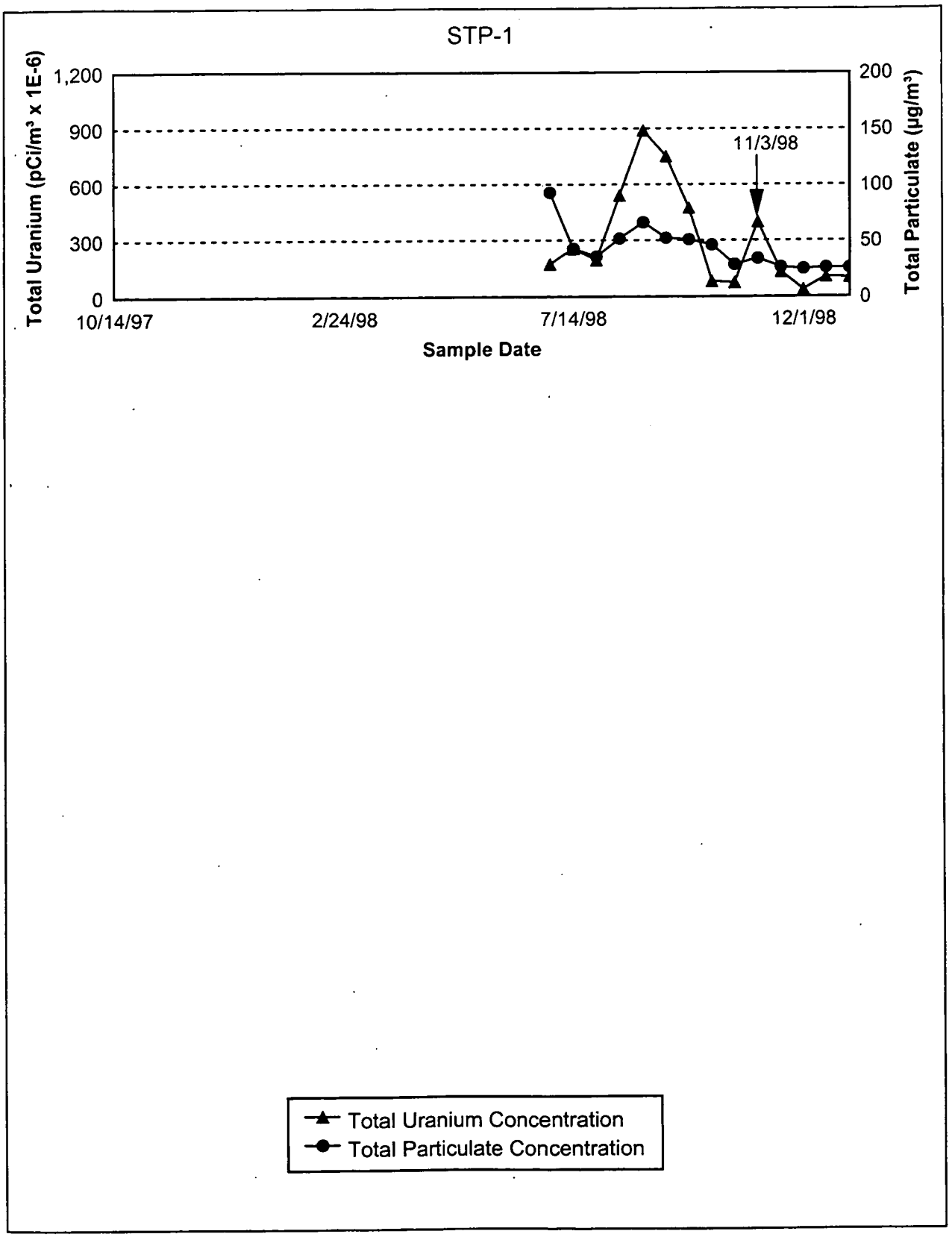
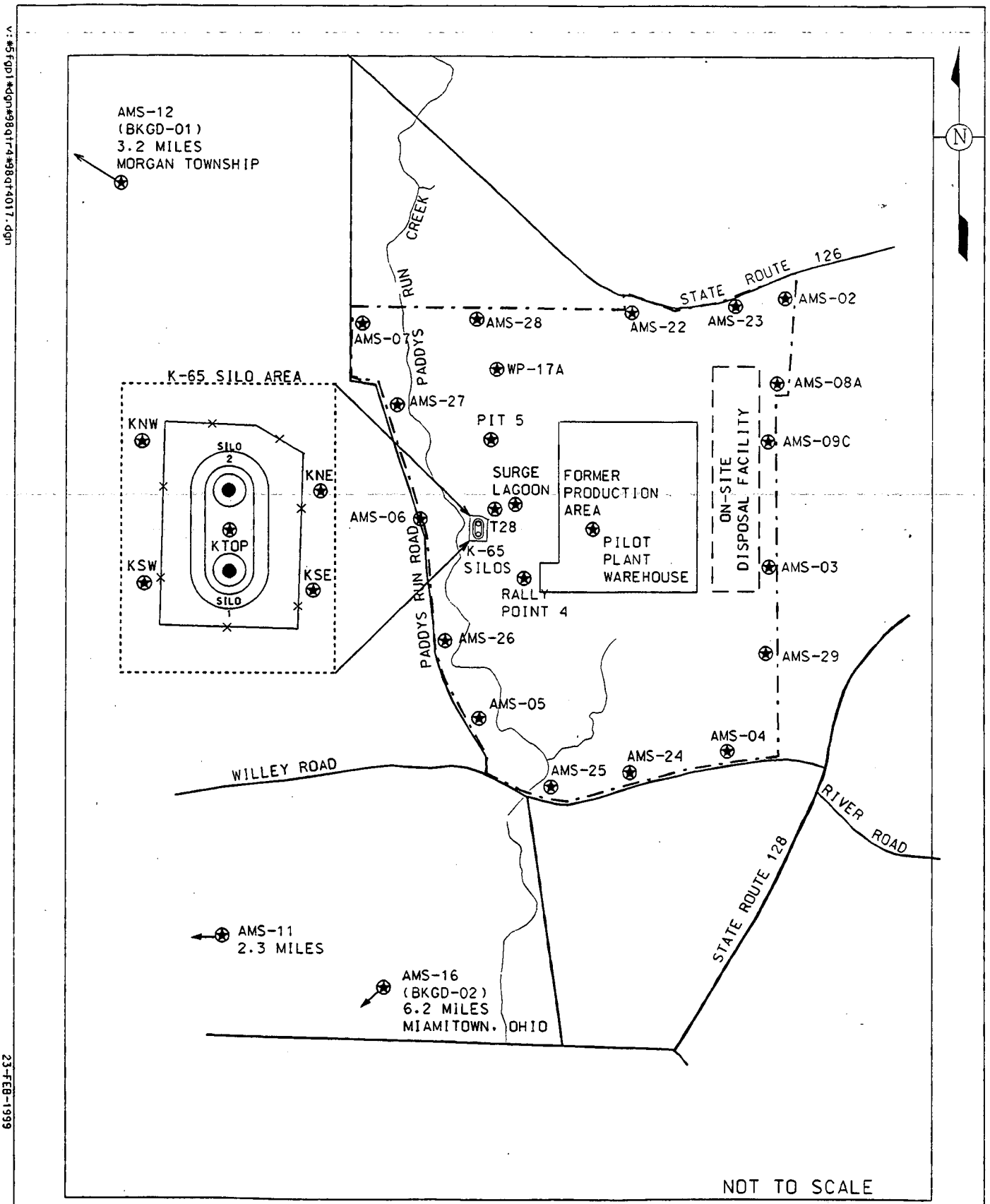


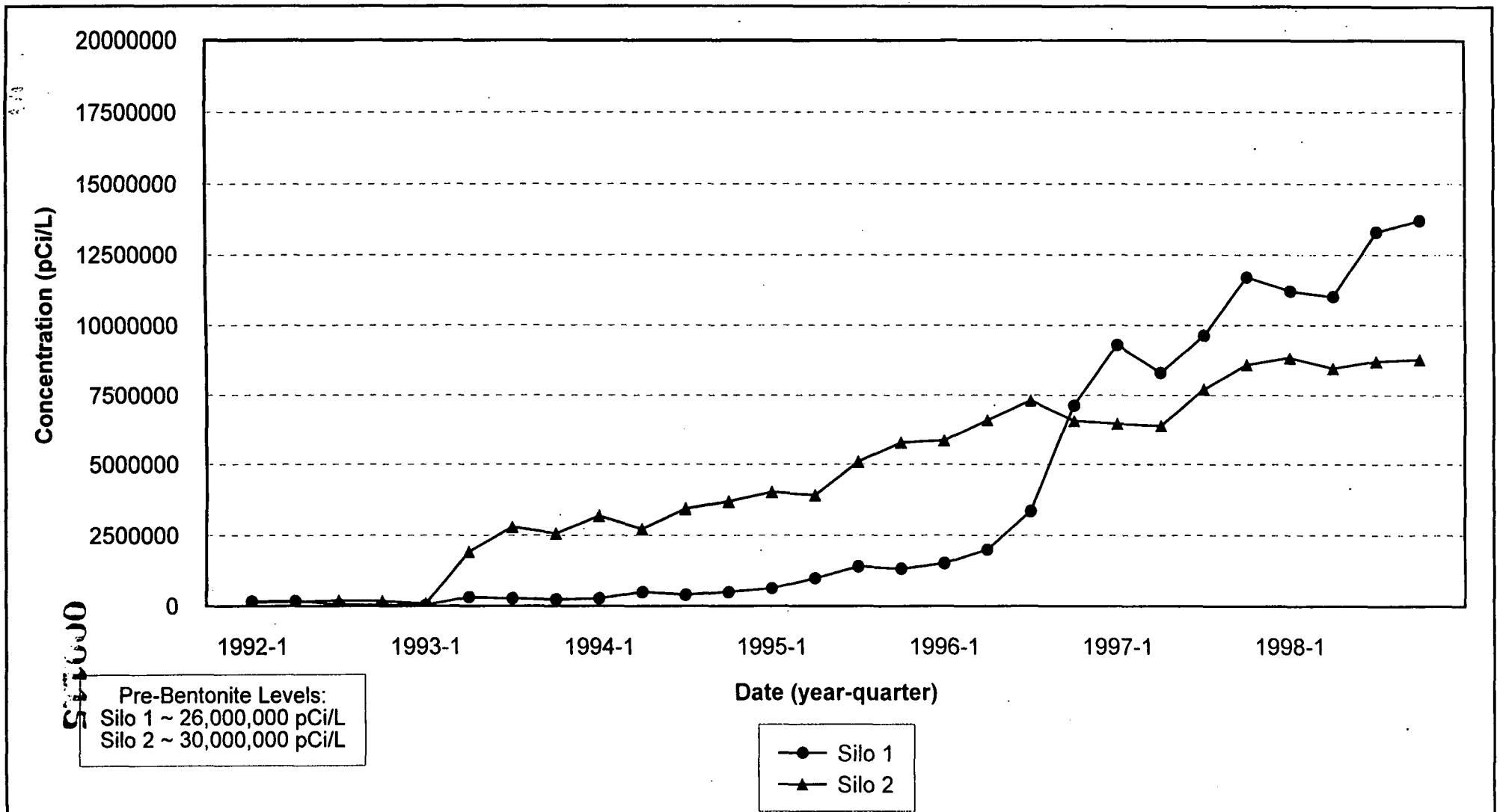
FIGURE 3-10. TOTAL URANIUM AND PARTICULATE CONCENTRATIONS IN AIR (STP-1)



LEGEND:

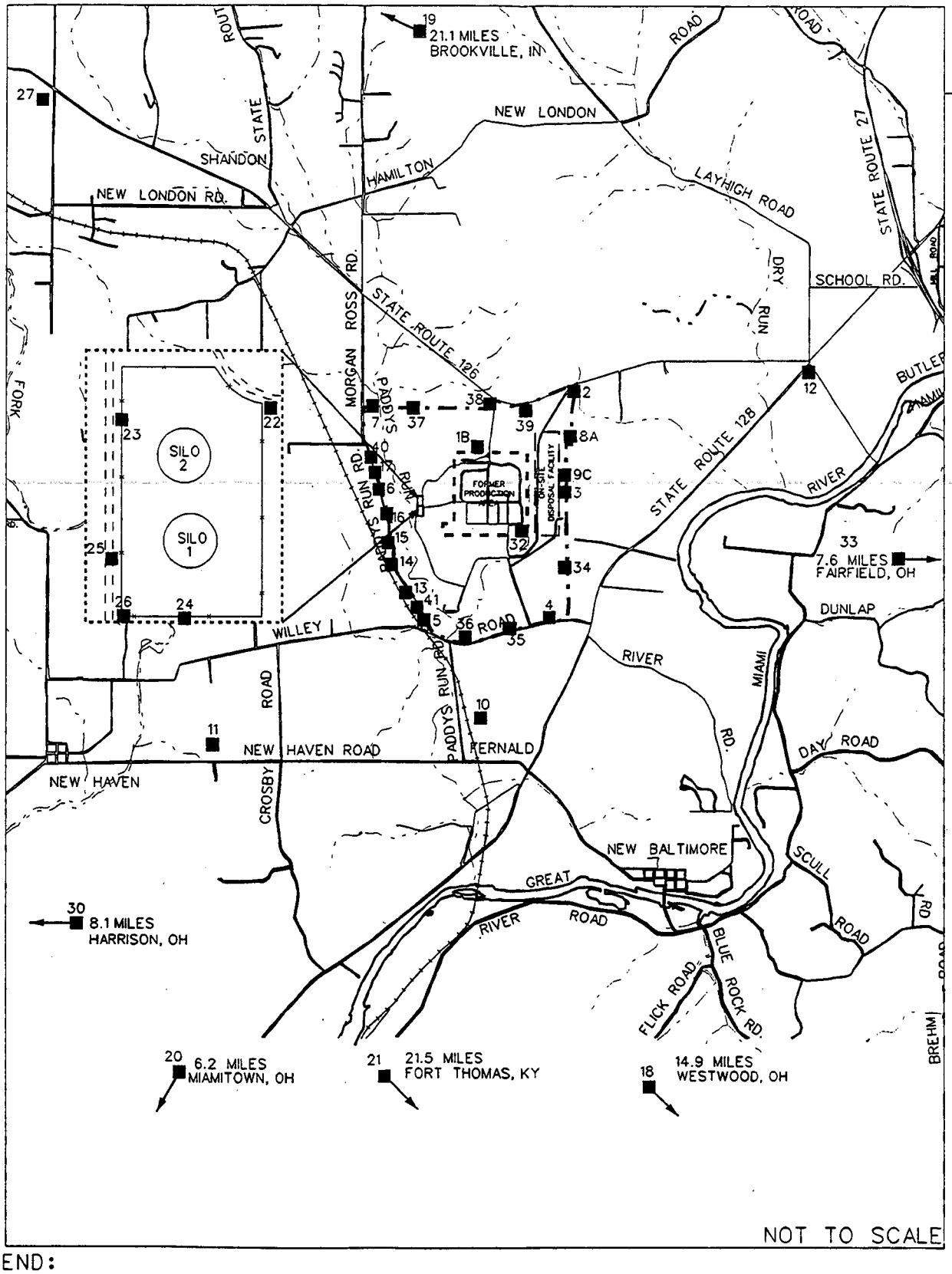
- FEMP BOUNDARY
- ENVIRONMENTAL RADON MONITORING - CONTINUOUS ALPHA SCINTILLATION LOCATION
- DISTANCE FROM CENTER OF FORMER PRODUCTION AREA TO LOCATION OFF MAP
- SILO HEAD SPACE RADON MONITORING - CONTINUOUS ALPHA SCINTILLATION LOCATION

FIGURE 3-11. RADON MONITORING - CONTINUOUS ALPHA SCINTILLATION LOCATIONS



NOTE: Defective sample line for Silo 1 was replaced during fourth quarter 1996.

FIGURE 3-12. QUARTERLY K-65 SILO HEAD SPACE RADON CONCENTRATIONS, 1992-1998



LEGEND:

- FEMP BOUNDARY
- DISTANCE FROM CENTER OF FORMER PRODUCTION AREA TO LOCATION OFF MAP
- DIRECT RADIATION (TLD) MONITORING LOCATION

FIGURE 3-13. DIRECT RADIATION (THERMOLUMINESCENT DOSIMETERS) MONITORING LOCATIONS

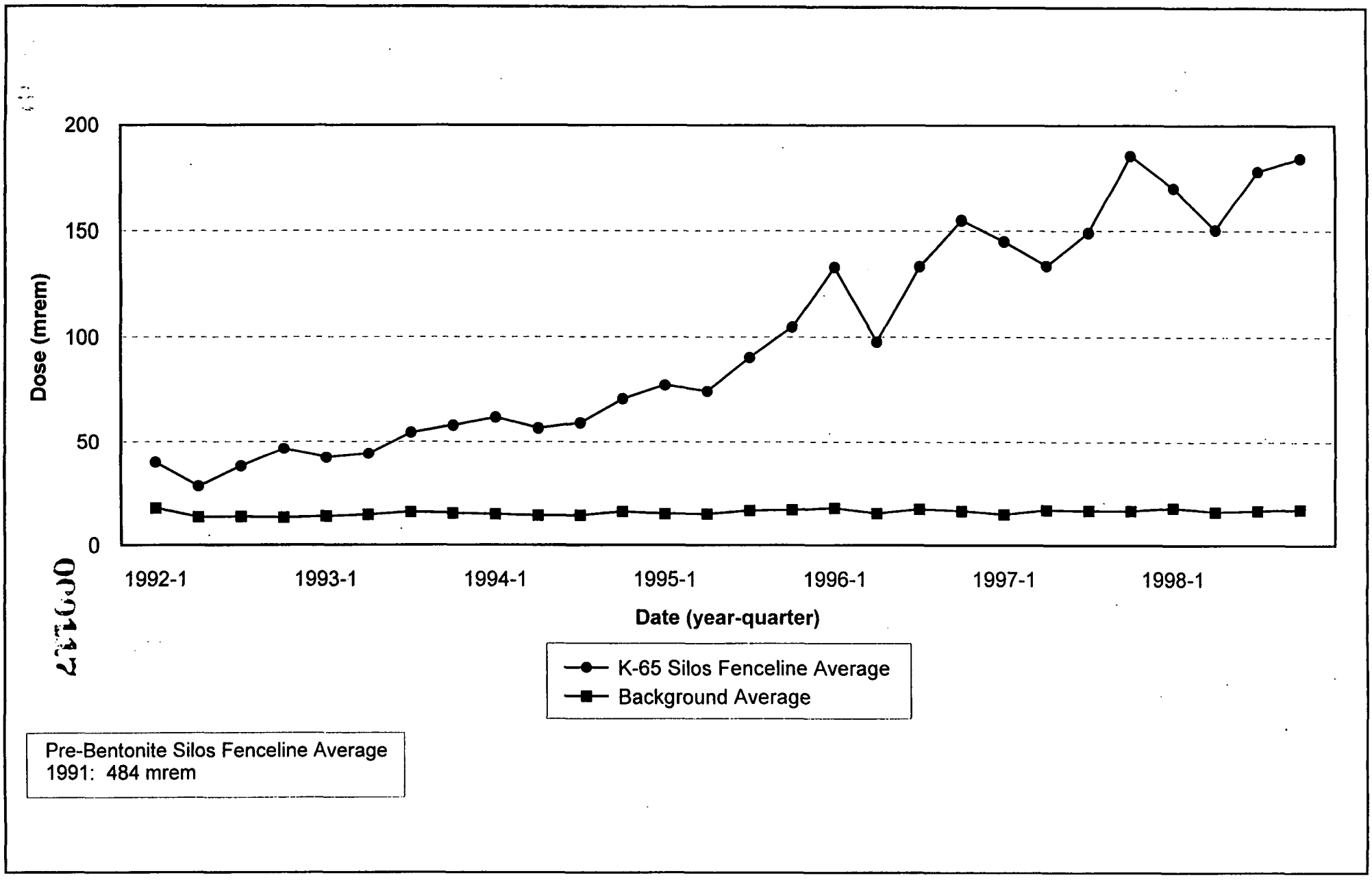


FIGURE 3-14. QUARTERLY DIRECT RADIATION (TLD) MEASUREMENTS, 1992-1998
(K-65 SILOS FENCELINE AVERAGE VERSUS BACKGROUND AVERAGE)

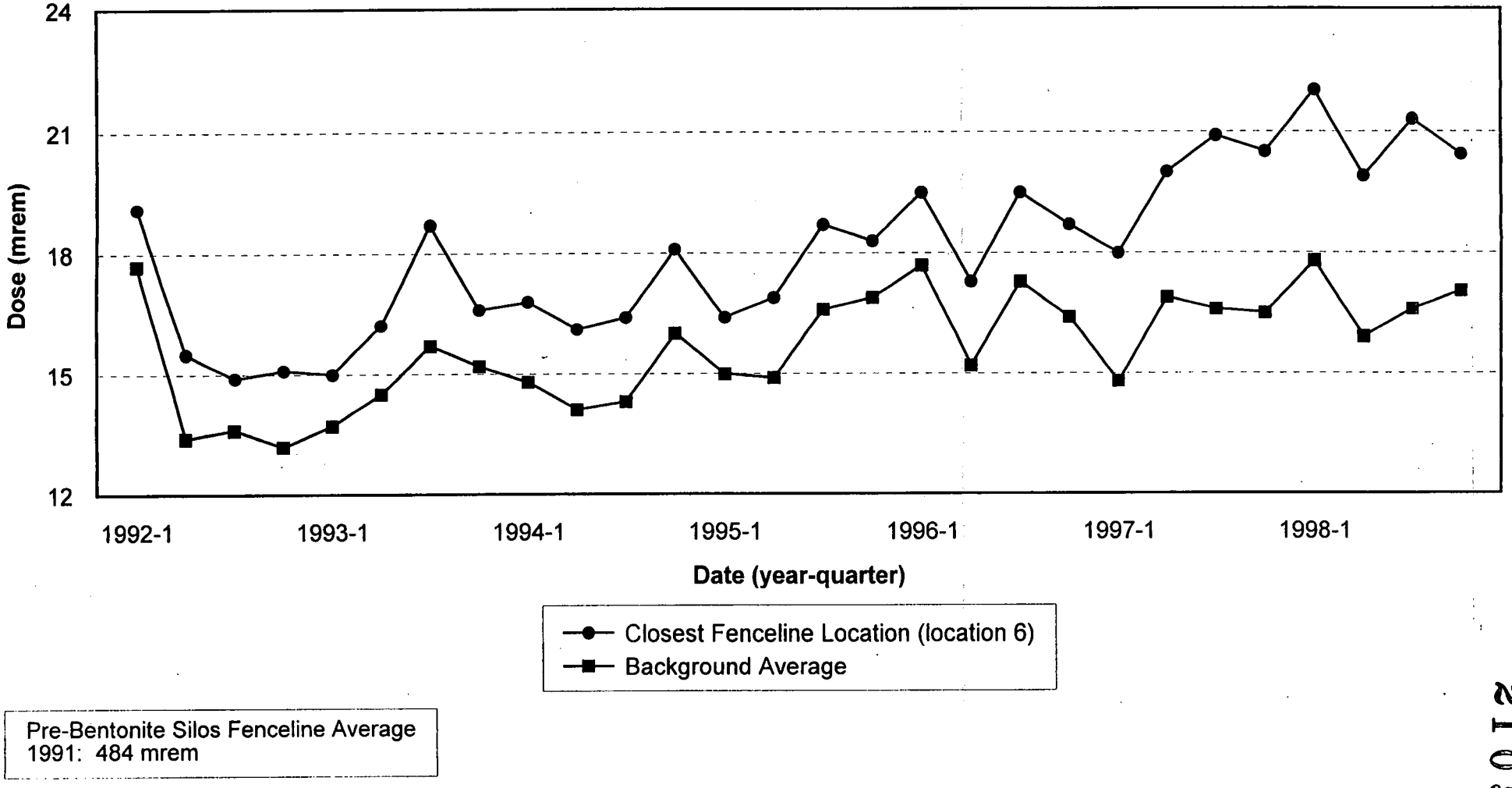


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FIGURE 3-15. QUARTERLY DIRECT RADIATION (TLD) MEASUREMENTS, 1992-1998
(LOCATION 6 VERSUS BACKGROUND AVERAGE)

009118

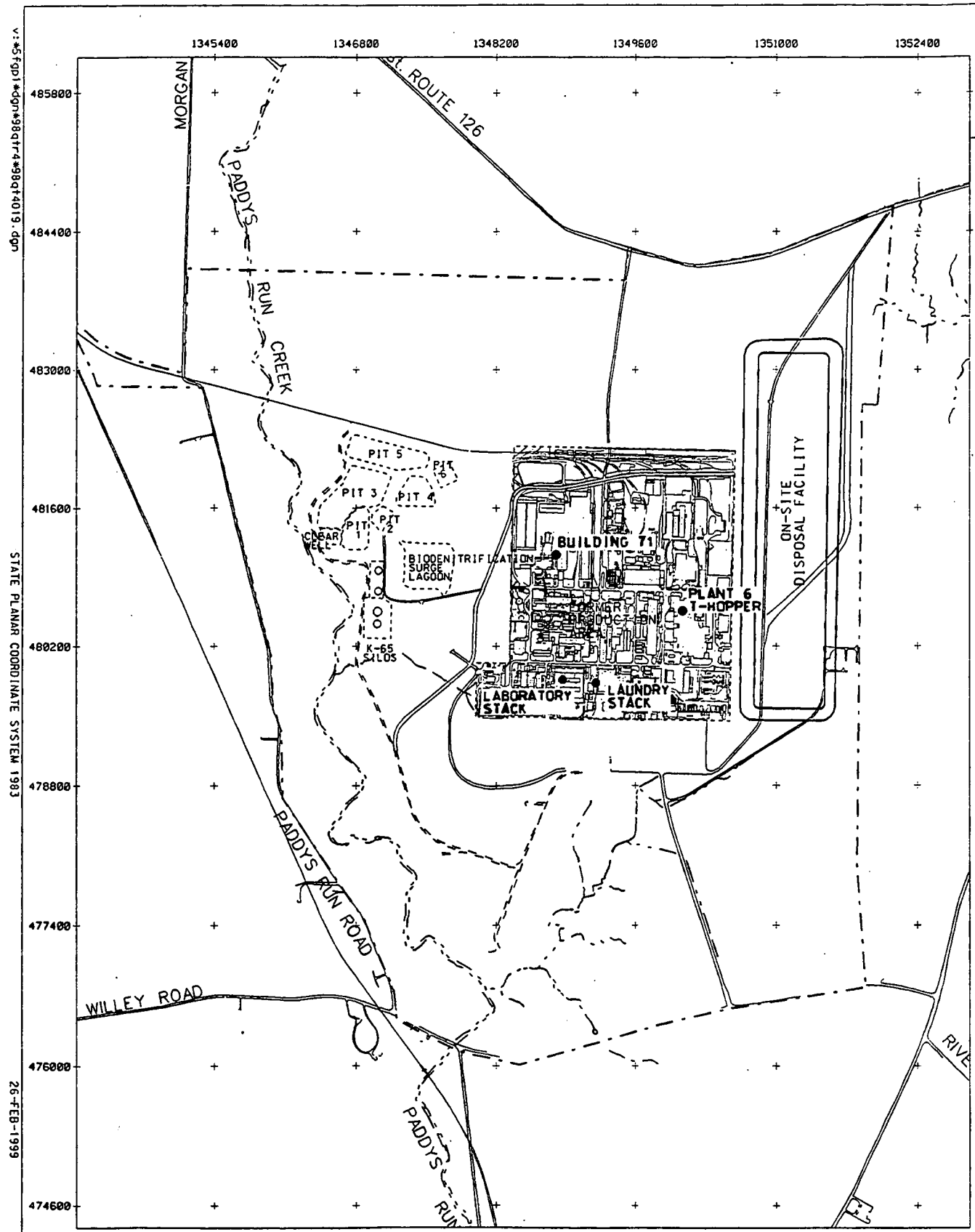

FIGURE 3-16. NESHAP STACK EMISSION MONITORING LOCATIONS

FIGURE 3-17

AIR SAMPLING ACTIVITIES COVERED IN THE NEXT QUARTERLY REPORT

SAMPLING ACTIVITIES	1999											
	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Radiological Particulate Monitoring:	♦	♦	♦									
NESHAP Quarterly Composite			♦									
Radon Monitoring - Continuous Alpha Scintillation Monitors	♦	♦	♦									
Radon Monitoring - Alpha Track-Etch Cups[a]												
Direct Radiation (TLD) Monitoring			♦									
NESHAP Stack Emissions Monitoring	♦	♦	♦									

♦ Data summarized/ evaluated in the next report

[a]Fourth quarter 1998 data will be included in the 1998 Integrated Site Environmental Report.

4.0 NATURAL RESOURCES UPDATE

This section provides a summary of newly impacted or ecologically restored areas, as well as a status of wetlands and endangered species at the FEMP.

There were no habitat impacts during the fourth quarter of 1998; however, two ecological restoration projects were completed. One project involved constructing an aesthetic barrier, which consisted of planting several rows of conifers and deciduous trees to reduce the view of Area 1 Phase II borrow operations. This barrier was installed on the FEMP property along Willey Road. This project is the first in a series of ecological restoration projects aimed at resolving DOE's natural resource damage liability, as identified in the Draft Final Natural Resource Restoration Plan (DOE 1998e). The second project involved the construction of the Fernald Ecological Restoration Park. This project provides an on-property wildlife viewing area that is accessible to the public. Several different habitats have been planted within this park, including old field, successional woodlot, oak-hickory forest, beech-maple forest, tallgrass prairie, and tallgrass savanna. An additional aspect of this project involved the construction of two overlooks for viewing several other habitats that will be restored through research efforts. This project was conducted as one of five environmental projects required under a dispute resolution agreement between DOE, EPA, and OEPA for missed Operable Unit 4 milestones (EPA 1997).

Sloan's Crayfish monitoring continued during the fourth quarter of 1998 and no unexpected conditions were observed. Any increase in turbidity was a function of flow resulting from precipitation rather than from FEMP construction area runoff. Therefore, the FEMP had no impact on Sloan's Crayfish populations during fourth quarter 1998.

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